

Critique of SCHEER Opinion Report on Health Risks from Radiofrequency Radiation

**A review of the EU expert group and opinion of August 2022
on the need of a revision of the maximum exposure limits for
radiation from wireless communications
2nd edition**



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Critique of SCHEER Opinion Report on Health Risks from Radiofrequency Radiation. A review of the EU expert group and opinion of August 2022 on the need of a revision of the maximum exposure limits for radiation from wireless communications. 2nd Edition March 31 2023

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Front page picture: 5G base station on building at street level (1st floor) in central Stockholm (Arenavägen, 2022)

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Summary

Highlights

- The vast majority of field experts agree that the ICNIRP 1998 limits recommended by EU allow exposure to harmful levels of radiation and that they must be stricter.
- Harmful effects from wireless technology radiation below the ICNIRP limits are clearly established by science.
- The EU Commission scientific advisory group (SCHEER) advises positively on adoption of new ICNIRP 2020 exposure limits allowing even more harmful RF radiation exposure.
- The SCHEER Opinion is biased and appear to be designed to find no risks and to greenlight the adoption of exposure limits that benefits industry.
- SCHEER working group members belong to a small self-referencing circle of no-risk pro-ICNIRP advocates, with ties to telecoms industry.
- The SCHEER panel do not meet the basic requirement for risk assessors: The demand for excellence and absence of economic or political ties.
- The SCHEER methodology for assessing the scientific evidence is insufficient, severely biased, and unscientific. A central thread throughout SCHEER report is the manufacture of doubt about harmful effects instead of an objective assessment of the science.
- SCHEER report overlaps risk assessment and risk management - a no-go in public health.
- There is an urgent need for complete re-evaluation of the science.
- The proper EU body to undertake such a risk analysis is the European Environmental Agency.

Context

The EU Commission scientific advisory group, SCHEER, has released a draft opinion report¹ on the possible risks from exposure to wireless technology like 5G, 4G, cellphones, Wi-Fi etc. The SCHEER Opinion published in August 2022 advises positively on the adoption of the ICNIRP 2020 limits, in stark contrast to the opinion of the majority of field experts, concluding that ICNIRP limits are far too high, allowing radiation exposures known to cause harmful effects.

As for the previous SCENIHR reports (2007, 2009 and 2015), with the appointed SCHEER advisory group, the European Commission has failed to include representatives from the vast majority of scientific experts, who agree that there is sufficient evidence of health risks well below the EU Commission endorsed ICNIRP exposure guidelines in order to adopt more protective limits.

The EU Commission has appointed only eight scientists to produce the SCHEER Opinion report 2022 (the working group). The chosen scientists are either not experts in the field, or scientists who have previously expressed opinions favorable to upholding the prevailing exposure limits, and some members even having ties to the telecommunications industry.

¹ https://health.ec.europa.eu/system/files/2022-08/scheer_o_044_0.pdf

A common thread runs throughout the SCHEER Opinion 2022 report: The manufacture of doubt about the abundant scientific evidence of harmful effects from the radiofrequency radiation (RFR) emitted by the telecommunications industry. On the other hand, no-effect studies are accepted without relevant criticism.

Applying the SCHEER methodology on e.g., smoking, would render the evidence on health effects of smoking "very weak". Producing flawed "no-effect" studies and ensuring that these are weighed equally to studies finding effects is the method the tobacco industry used for decades to protect their products, as described in the EEA report "Late lessons from early warnings" (2013)².

Abundant evidence shows severe effects on flora and fauna³, in particular on plant physiology and insects, with potential devastating effects for biodiversity and the ecosystem. SCHEER fails to point out the need of a revision of the guidelines to include protection of the flora and fauna. The effects on the environment, such as effects on birds and insects, are completely ignored by the SCHEER report.

A predetermined Outcome by Design

Upholding and adopting the new ICNIRP 2020 guidelines is of paramount importance to the telecommunications industry. A presentation from Ericsson, a major telecommunications infrastructure provider, serves as an illustration to the fact that lower limits than those recommended by ICNIRP is considered a risk to this industry. It will become difficult or impossible to roll out 5G if 100 times lower limits are applied. However even lower limits are requested by a majority of the RF-EMF scientists.

The obvious beneficiary of the manufactured doubt on harmful health effects is the telecommunication industry while the loser is the public health and the environment

Self-referencing Scientists create an Illusion of Consensus

Journalists from *Investigate Europe* uncovered how a close-knit circle of pro-ICNIRP scientists, "the ICNIRP Cartel", some with documented ties to telecom interests, sat on all major official science review boards and referenced each other, thus creating an illusion of scientific consensus of no-risk from wireless technology products.

The SCHEER working group forms part of this closed circle of a few self-referencing expert groups. The SCHEER opinion report repeatedly refers to other reports from scientist groups within this closed circle. At the center of this circle is the officially sounding *International Commission on Non-Ionizing Radiation Protection*, or ICNIRP for short. ICNIRP is in fact a private invitation-only club.

The EU Commission endorses exposure limits set by ICNIRP that only protect from acute, intense exposure heating effects. This endorsement, known as *Council Recommendation 1999/519/EC and Directive 2013/35/EU*, is based on what ICNIRP deems to be "established effects" by the highest degree of proof. This extreme view of the evidence effectively short-circuits protection against other harmful effects than heating and the *precautionary principle*.

² www.eea.europa.eu/publications/late-lessons-2/late-lessons-2-full-report/late-lessons-from-early-warnings/view

³ See footnotes 7-9 below

There are many clear indications throughout the report that the SCHEER report is biased towards the ICNIRP perspective, thus rendering support for telecommunications industry interests ahead of public health protection. This is for instance, expressed in the report's suggestion on how to handle that the new 5G technology "can trigger the population's concern about potential health risks" due to the permitted doubling of base station transmitted power compared to 4G and a health risk from high-intensity beam-formation. SCHEER proposes to handle the public concern by changing the way of measuring exposure while making a reference to a paper by the major telecommunication infrastructure provider Ericsson.

SCHEER Report conflicts with vast majority of Field Experts

The majority of 256 scientists from this field of research, with more than 2000 peer reviewed studies among them, have signed a joint statement¹⁴ (EMF-Scientist Appeal) demanding better protection in terms of lower limits for RFR exposure due to the growing evidence of harmful effects well below the ICNIRP limits: "It is our opinion that, because the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, they are insufficient to protect public health."

In October 2022, a group of 16 world leading scientists within the independent *International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)* published a peer reviewed paper providing evidence that the ICNIRP limits endorsed by the EU Commission, are based on false and outdated assumptions, and do not protect against harmful effects. Also concluding that the exposure limits must be lowered, and that the 5G roll-out must be halted:

*"The past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm"*⁵

Harmful Effects from Wireless Technology use clearly established in Science

Among the effects that have been documented to occur below the threshold of the EU Commission endorsed ICNIRP limits are: Negative effects on the brain and the nervous system, behavioral effects (symptoms such as headache, dizziness, and sleep disturbances), DNA-damage, oxidative stress, harmful effects on sperms and increased risk of cancer. Alone, the formation of reactive oxidative compounds (ROS) and the resulting oxidative stress has been evidenced in more than 200 scientific papers⁶, and is a likely cause of many other of the observed effects, as ROS interfere with basic cellular functions.

There is also a growing body of evidence of harmful effects on flora and fauna^{7,8,9}, including solid evidence of negative physiologic effects on plants¹⁰ and an array of negative effects on insects.

⁴ <https://emfscientist.org/index.php/emf-scientist-appeal>

⁵ https://icbe-emf.org/wp-content/uploads/2022/10/ICBE-EMF-paper-12940_2022_900_OnlinePDF_Patched-1.pdf

⁶ Carpenter et al. 2022 <https://jamanetwork.com/journals/jamaoncology/article-abstract/2791555>

⁷ Levitt et al., 2021a, Levitt et al., 2021b, Levitt et al., 2021c).

⁸ <https://pubmed.ncbi.nlm.nih.gov/27650031/>

⁹ https://ehtrust.org/wp-content/uploads/Thill_Review_Insects_2020_Engl.pdf

¹⁰ https://eklipse.eu/wp-content/uploads/2020/10/EMR-KnowledgeOverviewReport_FINAL_27042018-1.pdf

In addition, the 5G Appeal, signed by over 420 scientists and medical doctors, concludes that 5G will lead to “potential serious health effects” and a “massive increase of mandatory exposure” to radiofrequency radiation. The 5G Appeal has repeatedly been communicated to the EU Commission.¹¹ The first two studies on health effects in humans from 5G base station radiation published in 2023 (case studies) confirmed that 5G increase radiation exposure massively, indicating that 5G rapidly can symptoms known as the microwave syndrome although the levels were below the ICNIRP limits.^{12,13}

In 2016, a group of European medical doctors published the EUROPAEM EMF guidelines. In this publication it is recommended that exposure to RF should not exceed between 0.000001% to 0.001% of ICNIRP limit during extended exposure (at least 4 hours a day) to frequencies between GSM 900 to Wi-Fi 5,6 GHz, depending on sensitivity, night-time or daytime exposure. Thus, very much lower maximum levels than the ICNIRP 2020 levels of 10 million microwatts per square meter averaged over 6 or 30 minutes.

In striking contrast to the ICBE-EMF's and the EMF-Scientist groups conclusions and the available evidence, the authors of the SCHEER Opinion report claim they “*Could not identify moderate or strong level of evidence for adverse health effects resulting from chronic or acute RF EMF exposure at levels below the limits set in the annexes of Council Recommendation 1999/519/EC and Directive 2013/35/EU*” (i.e. below the ICNIRP limits set in 1998). Therefore, SCHEER advise positively on the adoption of the updated ICNIRP 2020 guidelines.

The SCHEER Opinion mixes Risk Assessments and Risk Management - in conflict with Public Health Principles

The task for the SCHEER group is to “*assist the Commission in the preparation of legislative proposals and policy initiatives*”. Thus, SCHEER is part of the political system, and the main task of SCHEER is to assist in risk management.

The present SCHEER report comprises both an assessment of the science and an opinion (risk management), which is in clear conflict with the principle of a clear separation of risk assessment and risk management. It also fails regarding both excellence and independence. Half of the working group's members are not experts on RF health effects and the other half has conflicts of interests, thus not fulfilling the criteria of independence.

The European Environmental Agency, EEA was established in the '90s due to the acknowledgment that a clear distinction between the European political system (responsible for risk management) and the organization, providing the scientific risk assessment, is crucial.

The main task of the EEA is to provide sound, independent information on the environment and related public health, including scientific risk assessments. The basis and motives behind the judgments that are fundamental in the assessment of risk and the handling of uncertainty, is a major

¹¹ <https://pubmed.ncbi.nlm.nih.gov/36129168/>

¹² https://www.gavinpublishers.com/assets/articles_pdf/Case-Report-The-Microwave-Syndrome-after-Installation-of-5G-Emphasizes-the-Need-for--Protection-from-Radiofrequency-Radiation.pdf

¹³ https://www.gavinpublishersanncaserep.com/assets/articles_pdf/Case-Report-The-Microwave-Syndrome-after-Installationopen-access/development-of-5G-Emphasizes-the-Need-for--Protection-from-Radiofrequency-Radiationmicrowave-syndrome-in-two-men-shortly-after-9589.pdf

contentious area. Therefore, it is a main obligation for the EEA to ensure that the scientific assessors are not biased due to political and economic interests.

As radiation from wireless technology is an emerging hazard, with huge amounts of scientific evidence for adverse effects, the SCHEER committee (or the EU Commission) should request the EEA to perform the independent risk assessment of the science, as a tool for the subsequent risk management process.

The Methods of SCHEER are biased

This critical review of the SCHEER Opinion 2022 has identified several examples of bias that drive the report towards a conclusion of no-risk.

Among the clear biased methods identified in this critical review are the selection of included reports with a majority referring to the closed circle of the ICNIRP Cartel. Another is the evaluation of the included studies with a clear tendency to draw conclusions such as “strong evidence for no effects” although there is evidence of effects; or “effects are uncertain” although there is strong evidence for health effects.

One such example of biased evaluation is the clear and consistent evidence for increased risk of brain tumors in mobile phone users with more than 10 years of exposure in the heaviest user group. This has been the result of repeated meta-analysis of available epidemiological studies. In this case SCHEER chose create doubt about the solid evidence, by referring to “significant criticism” from two letters to the scientific journal editor of one of these meta-analyses. The two letters were each coauthored by members of ICNIRP, thus propagating the ICNIRP cartel biased view. SCHEER also fails to mention that the evidence of cancerous effects is consolidated by the solid evidence of oxidative stress and DNA damage caused by the radiation (i.e. evidence for the mechanism) and further the cancerous effects found in large animal studies.¹⁴ Other experts conclude: *“When the cumulative body of evidence is assessed, the overall picture on low-intensity nonthermal levels of RFR [radiofrequency radiation] shows a clear and consistent pattern of adverse effects that form the basis of the mechanisms whereby RFR can cause the cancers seen in human populations.”*¹⁵

Further, regarding studies that do not find effects, SCHEER fails to analyze whether it has failed because of poor study design, e.g., irrelevant exposure. In contrast, irrelevant criteria are used to discard a large body of studies that finds effects, e.g., the strict demands for dosimetry, where it is not relevant or pertinent.

In addition, SCHEER fails to specify whether its conclusion of “no effects” is based on studies on short-term exposure or long-term exposure. One such example concerns the cardiovascular effects. Here SCHEER concludes that there is “strong evidence for no-effect” (in itself an unscientific conclusion). This conclusion is based mainly on experimental human short term exposure studies (minutes to an hour), while ignoring several long-term exposure studies showing adverse effects. Thus, the SCHEER conclusion is severely misleading. A recent scientific review by other scientists concluded that radiation from wireless technology may indeed affect the heart¹⁶.

¹⁴ <https://www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html>

¹⁵ Carpenter et al. 2022 <https://jamanetwork.com/journals/jamaoncology/article-abstract/2791555>

¹⁶ <https://www.ewg.org/research/radiofrequency-electromagnetic-fields-may-affect-heart-health-new-ewg-analysis-finds>

Conclusion

The SCHEER report should be dismissed and a new objective evaluation of the risks to health and the environment must be undertaken by competent experts without conflicts of interests and ties to industry. The report is extremely biased about the current scientific evidence of health risks. It cannot be used as a basis for decisions on new exposure limits for the prevention of harmful health and environmental effects. The relevant EU body to manage the new evaluation procedure is The European Environmental Agency.

1. Background

The EU Commission scientific advisory group, SCHEER, has released a draft opinion report¹⁷ on the possible risks from exposure to wireless technology like 5G, 4G, mobile phones, Wi-Fi etc. The SCHEER Opinion published in August 2022 advises positively on the adoption of the ICNIRP 2020 limits, in stark contrast to the opinion of the majority of field experts, concluding that ICNIRP limits are far too high, allowing radiation exposures known to cause harmful effects.

1.1 Why was the SCHEER Opinion Report Commissioned?

ICNIRP (International Commission on Non-Ionizing Radiation Protection) is a controversial private organization, which has recommended inadequate limits for maximum exposure of humans to radiofrequency radiation (RFR) from wireless technologies such as 5G, 4G, 3G and Wi-Fi. In 2020, ICNIRP issued new limits (or guidelines), presenting even more liberal limits allowing for the unrestricted roll-out of 5G.

The European Commission has ever since 1999 endorsed the ICNIRP guidelines issued in 1998, despite growing criticism of their inability to protect against harmful effects from long term RFR exposure.

Thus, the EU Commission asked its scientific advisory group, SCHEER, if there was a need of a revision of the Council Recommendation 1999/519/EC annexes and of the annexes of Directive 2013/35/EU *“in view of the latest scientific evidence available, in particular the ICNIRP guidelines updated in 2020 with regard to radio frequency (100 kHz to 300 GHz).”*

1.2 What are the ICNIRP Guidelines?

Both the ICNIRP 1998 and the 2020 guidelines protect only against acute thermal effects of RFR, occurring when the radiation is so intense that it causes a temperature increase by one degree Celsius within 30 minutes of exposure and thereby causing immediate irreversible effects due to the heating. The assumptions underlying the limits are that health effects can only arise from tissue heating, and that no other effects (i.e., by other mechanisms than heating) can occur at levels at lower intensities from continued exposure over time.

In October 2022, a competing radiation protection commission, the International Commission on Biological Effects from Electromagnetic Fields (ICBE-EMF), concluded that the ICNIRP limits (and thus the EU Commission Recommendation 1999/519/EC) are based on flawed assumptions. The two major flawed assumptions are: *“any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold”*. Further, ICBE-EMF concluded that the last two decades of research on effects of RFR *“demonstrates that the assumptions underlying ...ICNIRP’s exposure limits are invalid and continue to present a public health harm.”*

Further in January 2023 a former prominent member of ICNIRP (2004-2016), James C. Lin, published an article in which he raises severe criticism on ICNIRP’s 2020 guidelines: *“the limits are based on obsolete information, circumvent important animal data, and even more so in the case of mm-wave radiation from 5G mobile communications for which there is a paucity of health effects studies in the*

¹⁷ https://health.ec.europa.eu/system/files/2022-08/scheer_o_044_0.pdf

published literature. They are flawed and are not applicable to long-term exposure at low levels. Instead of advances in science, they are predicated on misguided assumptions with outdated exposure metrics that do not adequately protect children, workers, and the public from exposure to the RF radiation or people with sensitivity to electromagnetic radiation from wireless devices and systems. Thus, many of the recommended limits are debatable and absent of scientific justification from the standpoint of safety and public health protection.”¹⁸

For full body exposure to 3G, 4G, 5G and WiFi, the maximum exposure of the general public to RFR in the EU Commission Recommendation 1999 is 10 W/m² averaged over 6 minutes. This is far above the levels where health effects have been shown to occur. It is also far above the levels recommended by the vast majority of independent scientists and physicians.

1.3 Do the ICNIRP 2020 Guidelines offer Better Protection?

The ICNIRP 2020 guidelines allow for even higher exposure values than the previous 1998 recommendations. These recommendations, which have been adopted during the last two decades by a majority of EU countries, would not allow for the high intensities that can arise from the beam forming 5G technology and the ultrahigh intensities that may arise in beam cross-fields (see also section 3.5 of this report). Thus, it appears that the reason for this maneuver, the ICNIRP 2020 guidelines, is an adaption to the needs of the industry ahead of the roll-out of 5G and forthcoming generations of telecommunication. In the table below, ICNIRP 1998 guidelines (EU 1999 recommendations) are compared to the new ICNIRP 2020 guidelines.

Table 1. ICNIRP 1998 and 2020 reference levels (W/m²) (source: Hardell et al. 2021)¹⁹.

| Frequency (MHz) | Example usage | ICNIPR 1998 reference level, 6 min | ICNIPR 2020 reference levels, whole body exposure, 30 min | ICNIPR 2020 reference levels, local exposure, 6 min |
|-----------------|---------------|------------------------------------|---|---|
| 800 | LTE | 4 | 4 | 18.2 |
| 900 | GSM, UMTS | 4.5 | 4.5 | 20.1 |
| 1,800 | GSM | 9 | 9 | 36.6 |
| 1,900 | DECT | 9.5 | 9.5 | 38.3 |
| 2,100 | UMTS | 10 | 10 | 40 |
| 2,400 | WiFi 2G | 10 | 10 | 40 |
| 2,600 | LTE | 10 | 10 | 40 |
| 3,500 | 5G, WiMax | 10 | 10 | 40 |
| 5,500 | WiFi 5G | 10 | 10 | 40 |
| 26,000 | 5G | 10 | 10 | 30.9 |

The ICNIRP 2020 guidelines introduce reference levels for “local exposure” that allow much higher exposure. Further, the averaging time is raised from 6 minutes to 30 minutes. ICNIRP argues that this

¹⁸ <https://pubmed.ncbi.nlm.nih.gov/36706903/>

¹⁹ <https://www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html>

rise in allowed exposure has been made to better match the time needed for body core temperature to rise. This argument further illustrates the unscientific and obsolete approach by ICNIRP, as local temperature rises can cause local tissue damage without a rise of the core temperature. Such acute damage would cause devastating effects, e.g., in the eye and in female gamete cells. Furthermore, in view of the substantial amount of research showing harmful effects from radiation levels that do not cause rise in temperature, these adjustments appear arbitrary and meaningless.

1.4 What has been Ignored by ICNIRP and the EU Commission?

During the last two decades, scientific evidence showing harmful effects from Radiofrequency electromagnetic radiation (RF radiation) has grown and accumulated to a substantial amount of clear evidence showing harmful effects on humans and animals from exposure below the ICNIRP exposure limits recommended by the EU Commission in 1999. This RF radiation is emitted into the environment from ubiquitous wireless technologies, such as 2G, 3G, 4G, 5G, Wi-Fi, et cetera.

Already in 1999, the very year the EU adopted ICNIRP guidelines, scientific evidence showed DNA-damage, brain damage and increased risk of cancer from exposure levels below the thermal exposure limits. There was also evidence of increased risk of various symptoms such as sleep disturbances, headache, dizziness caused by chronic exposure to RF at non-thermal levels^{20,21}. In 2009, the European Environmental Agency stated that there was sufficient evidence for health effects (DNA damage and cancer) below the ICNIRP guidelines to warrant the implementation of the precautionary principle²². This was ignored by the EU Commission.

Scientists in this research field have, since the start of this millennium, repeatedly called for better protection of the public and the environment against the many health and environmental effects associated with long term exposure below the ICNIRP thermal-based limits. As of today, a majority of the scientists in the field, (256) have signed the EMF Scientists Appeal²³ demanding better protection due to the growing evidence of harmful effects well below the ICNIRP limits: *“It is our opinion that, because the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, they are insufficient to protect public health”*.

Over 400 scientists and medical doctors have signed the 5G Appeal²⁴ asking for a moratorium of the 5G roll out due to potential serious health consequences and the massive increase of mandatory exposure.²⁵

In 2012, the BioInitiative Report which was prepared by 29 scientists from ten countries was published. It concluded that, already by then, harmful effects were “clearly established” at exposure intensities well below the ICNIRP limits, and further, *“public safety limits for electromagnetic and radiofrequency fields (ICNIRP) remain thousands of times higher than exposure levels that health studies consistently show to be associated with serious health impacts.”*²⁶ The BioInitiative group in

²⁰ <https://pubmed.ncbi.nlm.nih.gov/26556835/>

²¹ <https://pubmed.ncbi.nlm.nih.gov/32289567/>

²² Statement on Mobile Phones for Conference on Cell Phones and Health: Science and Public Policy Questions, Washington, 15 September 2009. Professor Jacqueline McGlade, Director, European Environmental Agency, Denmark September 15, 2009

²³ <https://emfscientist.org/>

²⁴ <https://www.5gappeal.eu>

²⁵ <http://www.5gappeal.eu/the-5g-appeal/>

²⁶ <https://bioinitiative.org/preface/>

2012 recommended an exposure limit for RFR radiation of 30-60 $\mu\text{W}/\text{m}^2$, even lower for sensitive persons and children, and 3-6 $\mu\text{W}/\text{m}^2$ for the protection against all known health effects. These recommended thresholds for protection against health effects from long term exposure are of an order of 1 million below the ICNIRP thresholds for protection against short term heating. In 2022 BioInitiative scientists concluded:

“When the cumulative body of evidence is assessed, the overall picture on low-intensity non-thermal levels of RFR [radiofrequency radiation] shows a clear and consistent pattern of adverse effects that form the basis of the mechanisms whereby RFR can cause the cancers seen in human populations. Of 261 studies looking at oxidative effects from RFR exposure, 240 (91%) showed damage. Of 346 studies on effects of RFR on genes, 224 (65%) reported genetic damage. Oxidative stress and genetic damage are the major mechanisms leading to cancer. In addition, RFR exposure causes effects on brain and behavior. Of 336 studies published on RFR neurological effects, 73% reported effects, and only 27% showed no effect.”²⁷

In 2016, European scientists and physicians published recommendations (The EUROPAEM EMF guidelines) for maximum exposure to RF radiation of 10-1 000 $\mu\text{W}/\text{m}^2$, at night-time down to 1-100 $\mu\text{W}/\text{m}^2$, and even lower for sensitive persons: 0.1-10 $\mu\text{W}/\text{m}^2$.

In October 2022, a group of 16 world-leading scientists within the *International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF)* published a peer reviewed paper, *“Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G.”* The scientist provide evidence that the ICNIRP limits are based on false and outdated assumptions, do not protect against harmful effects, and conclude that the exposure limits must be lowered, and that the 5G roll-out must be halted: *“ICNIRP’s exposure limits are invalid and continue to present a public health harm.”*

In November 2022 a former long-time member of ICNIRP, Professor James C. Lin, concluded in a peer-reviewed article: *“there are consistent indications from epidemiological studies and animal investigations that RF exposure is probably carcinogenic to humans. The principle of ALARA—as low as reasonably achievable—ought to be adopted as a strategy for RF health and safety protection.”²⁸*

Among the effects that have been documented to occur below the ICNIRP limits are negative effects on the brain and the nervous system (symptoms such as headache, dizziness and sleeping problems), behavioral effects, DNA-damage, oxidative stress, harmful effects on sperms, harmful cardiovascular effects, and an increased risk of cancer. There is extensive, solid evidence that these health effects occur from long term exposure below the current limits. For example, the formation of reactive oxidative compounds (ROS) and the resulting oxidative stress has been evidenced in over 200 scientific papers²⁵ and is a likely cause of many other of the observed effects, as ROS interfere with basic cellular functions, in particular at long term exposure, preventing the organism to cope. There are also a growing body of evidence of harmful effects on flora and fauna²⁹, including solid evidence of negative physiologic effects on plants³⁰ and an array of adverse effects on insects³¹.

²⁷ <https://jamanetwork.com/journals/jamaoncology/article-abstract/2791555>

²⁸ <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1042478/full>

²⁹ Levitt et al., 2021a, Levitt et al., 2021b, Levitt et al., 2021c).

³⁰ https://eklipse.eu/wp-content/uploads/2020/10/EMR-KnowledgeOverviewReport_FINAL_27042018-1.pdf

³¹ ehtrust.org/wp-content/uploads/Thill_Review_Insects_2020_Engl.pdf

1.5 The EU Commission's one-sided selection of Pro-ICNIRP Experts

From the scientific community, the EU Commission has chosen to select only eight scientists to produce the SCHEER Opinion Report 2022. The selected scientists are either not experts in the field or are scientists who have previously expressed opinions favorable to continued adherence to the ICNIRP limits – some of them with documented ties to the telecommunications industry. Furthermore, the EU Commission, for all the previous SCENIHR opinions on EMF (2007, 2009 and 2015) has picked only scientists with ties to industry and/or a positive attitude to ICNIRP limits or even other members of ICNIRP.³² The 2015 SCENIHR report as well as the ICNIRP 2020 report are used as a basis for the present SCHEER report and widely cited, uncritically, in the SCHEER report as if the two reports were evidenced, established truths. Evidently, that the SCHEER and previous SCENIHR reports are biased in favour of ICNIRP's position, despite the growing scientific criticism.

Why?

1.6 ICNIRP Limits are important to the Industry

The ICNIRP limits are of tremendous importance to the telecommunications industry. The industry often refers to ICNIRP and the ICNIRP guidelines in their documents on health risks. Mobile and Wireless Forum for instance claim: *"The ICNIRP guidelines are based on decades of research into electromagnetic fields and human health. They establish the point at which adverse health effects are known to begin due to the heating of tissue and set limits 10 to 50 times (5000%) below that as maximum exposure levels for workers and for the public respectively. These limits therefore provide a large safety margin for all members of the community including children."*³³

A presentation from an employee at Ericsson, in charge of EMF and health issues, makes it clear that lower limits than those recommended by ICNIRP are considered a risk to the roll-out of 5G. It will become difficult or impossible to roll out 5G if 100 times lower limits are applied – while even lower limits are requested by a majority of RF-EMF scientists.³⁴

In 2020, a report from two European Parliament members was published highlighting the ties between ICNIRP, the IEEE and the telecommunications industry.³⁵ On page 43 – 44, examples of the lobbying by the telecom companies towards the EU commission for advantageous terms are presented with continuous referral by the industry to the safety of the ICNIRP limits. The European Telecommunications Networks Operators' Association (ETNO) has lobbied for the ICNIRP limits to be applied in the EU, claiming that ICNIRP limits are based on *"a sound scientific basis"*. ETNO is in favor of *"harmonized ICNIRP limits"*

The report of the EU MEPs also describes the massive lobbying activities by the telecom industry towards the EU Commission for favorable policies. At one industry organized event discussing the *"necessary steps to ensure the success of 5G in Europe"* the chairman of ICNIRP, Eric van Rongen, participated.

Further, the report from the EU MEPs notes the evidence of corruption within this industry:

³² <https://www.politico.eu/wp-content/uploads/2020/06/ICNIRP-report-JUNE-2020-BUCHNER-RIVASI.pdf>

³³ <https://www.emfhealth.info/how-wireless-works-standards.cfm>

³⁴ https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Documents/S3_Christer_Tornevik.pdf

³⁵ https://www.michele-rivasi.eu/wp-content/uploads/2020/06/ICNIRP-report-FINAL-JUNE-2020_EN.pdf

"It is important to note that the efforts of the telecom industry to influence regulatory agencies often take illegal forms. Telecommunications companies are high on the list of the companies that were penalised in the U.S. for corrupt practices. European companies like Ericsson, Alstom and Telia are in the top ten." ...

"The lobby power of the telecom-industry in Brussels, the decision-making heart of the EU, is enormous. Yet the corporations involved do not have to lobby the guidelines and health advice related to their technology, because ICNIRP has been providing the "safety certification" for over 25 years."

1.7 The Mandate of SCHEER

According to the new rules (April 2016) for the procedure of the scientific committees under the EU Commission, SCHEER may perform risk assessments. In that case, "The Scientific Committees shall perform their tasks in compliance with the principles of *excellence, independence, confidentiality, commitment and transparency*". The mandate of SCHEER is to "provide the Commission with the scientific advice it needs when preparing policy and proposals relating to consumer safety, public health and the environment. The Committees also draw the Commission's attention to new or emerging problems that may pose an actual or potential threat". More specifically, the task for the SCHEER group is to "Assist the Commission in the preparation of legislative proposals and policy initiatives".³⁶

Thus, the main task of SCHEER is to assist in risk management. SCHEER is part of the political system under the Commission, but the rules from 2016 allow SCHEER also to perform risk assessment. This mixture of risk assessment and risk management is against fundamental principles laid down in the WHO and the EU the purpose of which is to protect the public and the environment (see section 1.8).

1.8 The Task of EEA

The European agencies were created in recognition of the fact that a clear separation between the European policy system (risk management) and the organization providing the scientific advice (risk assessment) is crucial, in order to obtain objective risk assessment as a basis for policy making in the EU.

The main task of the European Environment Agency is to provide *sound, independent information* on the environment and related public health issues. The EEA is a major information source for those involved in developing, adopting, implementing, and evaluating environmental policy, and also an information source for the general public.

Risk assessments are a key element of the responsibility of the EEA. In an EEA report on state of the art for risk assessment³⁷, the following is stressed: "For risk assessments, the major contentious areas include the availability of data, the quality of the data used, the basis and motivations behind the judgments that are fundamental in the assessment of risk and the treatment of uncertainty."

³⁶ <https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?do=groupDetail.groupDetail&groupID=3422>

³⁷ www.eea.europa.eu/publications/GH-07-97-595-EN-C2/riskindex.html

Since the basis for the judgments are pertinent for the validity of the risk assessments, it is a main obligation for EEA to ensure that the scientific assessors are independent, i.e., not disqualified due to political and economic interests.

Already in 2009, the EEA called for the implementation of the *precautionary principle* to protect the human populations against possible health effect from RF radiation from telecommunication devices³⁸: “*The evidence is now strong enough, using the precautionary principle, to justify the following steps: 1. For governments, the mobile phone industry, and the public to take all reasonable measures to reduce exposures to EMF, especially to radio frequencies from mobile phones, and particularly the exposures to children and young adults who seem to be most at risk from head tumours.*”

This recommendation was since repeated by the EEA, e.g., in the report “Late Lessons from Early Warnings” in 2013: “*Precautionary actions now to reduce head exposures, as pointed out by the EEA in 2007, and many others since, would limit the size and seriousness of any brain tumour risk that may exist. Reducing exposures may also help to reduce the other possible harms...*”

The warnings and recommendations from the EEA have been ignored by the EU Commission. In view of the large amount of science on the effect of EMF published in the past decade, the EU commission should request a risk assessment from the proper, independent authority – the EEA; not from the politically appointed advisory group, SCHEER.

1.9 SCHEER's Lack of Excellence and Independence

The opinion report presented by SCHEER includes both an opinion and an "assessment" of the science, thus mixing risk assessment and risk management. Furthermore, this “assessment” does not live up to the basic criteria for hazard identification and risk assessment (as described by e.g., the EEA³⁹):

- The members do not at all represent *excellence* since many of the appointed members are not experts in the field. Leading scientists in the field are left out.
- Other members writing the opinion report have conflict of interest (ties with the industry), thus violating the criteria for *independence*.

The lack of excellence and independence is underscored by the low quality of the so-called "assessment", failing to meet basic scientific criteria. We refer to our comments on the individual sections, in particular the methodology section, documenting how SCHEER fails to meet basic scientific criteria. In brief,

- The selection of scientific evidence is biased.
- The evaluation of scientific evidence /the referenced material is insufficient and biased.
- The methodology applied for evaluating (“weighing”) the evidence is non-scientific, and the conclusions regarding the “weight of evidence” are in several chapters severely misleading.

In summary, the main task of SCHEER is to support the EU Commission in the risk management. SCHEER presents a mixture of an opinion (risk management advice) and hazard identification (risk

³⁸ Statement on Mobile Phones for Conference on Cell Phones and Health: Science and Public Policy Questions, Washington, 15 September 2009. Professor Jacqueline McGlade, Director, European Environmental Agency, Denmark September 15, 2009

³⁹ www.eea.europa.eu/publications/GH-07-97-595-EN-C2/riskindex.html

assessment). When SCHEER attempts to perform both risk assessment and risk management, it becomes a mixture of competences and a violation of the principle of a clear separation between risk assessment and risk management.

As the Terms of Reference (TOR) for SCHEER was to give an opinion (risk management support), the preceding risk assessment should be performed by independent bodies, preferably the European Agencies (EEA), to avoid conflicts of interest affecting the risk assessment.

The outcome of using experts with conflicts of interest and lack of excellence is foreseeable: SCHEER claims to present an assessment of the science, but the report does not meet basic scientific criteria and is heavily biased in favour of industry interests.

1.10 Terms of Reference for the SCHEER Report

The Terms of reference is cited in the report: *"The scientific committee SCHEER is consulted on the need of a (technical) revision of the 21 Council Recommendation 1999/519/EC annexes and of the annexes of Directive 22 2013/35/EU in view of the latest scientific evidence available, in particular the ICNIRP guidelines updated in 2020 23 14 with regard to radio frequency (100 kHz to 300 GHz)".*

Thus, the task for SCHEER was to give an opinion on the need for a revision of the recommendation. The task was not to make a scientific risk assessment. As the current technical standard has been defined by ICNIRP to protect against only thermal health effect from short term exposures, there are no exposure limits protecting against effects from long term- and non-thermal exposures. The substantial body of science shows repeatedly that there are harmful biological effects (e.g. oxidative stress and DNA damage) below the thermal limits both from short term and long term exposure.

Complete scientific agreement is rare in any research field – particularly in research fields where there are large economic interests at stake. Even though there is not complete scientific agreement regarding the health consequences of RF EMF, there can be no doubt that abundant scientific reports show – and hundreds of scientists with expertise in the field agree – that the radiation can cause harmful biological and health effects below the ICNIRP thermal based limits.

Therefore, the task for SCHEER was actually simple:

The current recommendation was based on the assumption that health effects cannot occur below the ICNIRP thermal limits. There is abundant and solid evidence showing that biological effects do occur below the thermal limits and thus, that ICNIRP's assumptions are wrong.

Consequently, the advice from SCHEER should have been this: *The recommendation should be revised to protect against potential non-thermal health effects according to the precautionary principle. A risk assessment should be performed by the competent authority, the EEA.*

Instead, SHCEER has chosen to mix risk-management and risk assessment, although the working group does not have competences for the latter.

2. Conflicts of Interests and Business as Usual

The EU Commission expert groups on EMF, the SCHEER (2022), and the previous SCENIHR groups (2007, 2009, 2015) do not constitute a balanced composition of experts, representative of the prevailing opinions of scientists on radiofrequency radiation effects on health.

It is no secret to the European Commission that hundreds of scientists or experts have clearly stated for many years that there is a substantial and expanding amount of scientific evidence showing that RF-EMF is harmful below the ICNIRP limits and furthermore, that ICNIRP limits are insufficient to ensure the protection of human health and biological systems. This is, for instance, expressed by the EMF Scientists Appeal, the 5G Appeal, the BioInitiative reports, the EUROPAEM EMF guidelines (2016)⁴⁰ and recently in the ICBE-EMF's conclusion: *"the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm."*⁴¹

All these scientists, critical of the ICNIRP limits that are recommended by the EU Commission since 1999, are never invited to take part in the Commission's expert groups. Rather, the appointed expert groups seem exclusively reserved for scientists with a previous expressed adherence to the harmful inadequate ICNIRP guidelines (see Table 1).

The ICNIRP exposure limits are, as an obvious result of the selected experts, endorsed by the previous SCENIHR groups and now also by the recent SCHEER group.

These guidelines were proposed to be upheld and even increased by ICNIRP in 2020⁴² in what appears to be an adaptation to the telecom industry's needs for the roll-out of 5G. That is exactly the opposite of what the vast majority of scientists performing research on RF biological effects are asking for, namely lowered limits that protect against harmful non-thermal effects.

2.1 A Predetermined Outcome by Design

The predecessors SCENIHR 2007, 2009 and 2015 were composed of experts with clear conflicts of interests in terms of membership of ICNIRP or IEEE/ICES or funding from the telecommunications industry. IEEE/ICES is an industry organization with many representatives from the telecom and military sector that sets limits based on only thermal effects similar to the ICNIRP exposure limits. All the SCENIHR reports gave the green light for the ICNIRP limits and thus for 'business as usual' to continue the expansion of wireless technologies without improved protection for the public (See Table 1).

The SCHEER Opinion 2022 is written by a working group of eight persons. Five are also SCHEER members and three are external consultants. Of the eight members, only four are experts on RF radiation. All these four members have ties to the industry in terms of research funding, membership of industry organization, or possessing shares in companies with business related to this issue.

⁴⁰ <https://europaem.eu/en/library/articles/europaem-emf-guideline-2016>

⁴¹ https://icbe-emf.org/wp-content/uploads/2022/10/ICBE-EMF-paper-12940_2022_900_OnlinePDF_Patched-1.pdf

⁴² <https://www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html>

The SCHEER report ignores a number of scientific reviews because the authors claim these have a “high risk of bias” (page 20). However, as we shall see below, 50% of the authors have themselves a high risk of bias due to ties and funding from industry and pro-industry organizations. Furthermore, they have made prior statements that are clearly in favor of the ICNIRP limits and thus to the telecommunications interests:

Theodoros Samaras: Associate member of IEEE/ICES.⁴³ IEEE has also sponsored several of his publications. He is a former employee of and advisor to IT’IS Foundation, an organization funded by major telecom companies⁴⁴, and a shareholder of Tessaloniki Software solutions.⁴⁵ He was also member of SCENIHR 2015 working group, which manufactured doubt about the evidence for harmful effects and then concluded that there were no adverse health effects.

Clemens Dasenbrock: Has received funding for research from Swiss Research Foundation for Electricity and Mobile Communication (FSM) that receives funding from telecommunications companies.⁴⁶ He has also been a member of ICNIRP (SEG) and of SSM (Swedish Radiation Safety Authority) expert group for several years. SSM’s report published in 2021 concluded that there is “no reason to change any reference levels or recommendations in the field”⁴⁷.

Heidi Danker-Hopfe: Has received funding for research from the Swiss Research Foundation for Electricity and Mobile Communication (FSM) since 2016. FSM receives funding from telecommunications companies.^{48,49} She is also a member of the SSM (Swedish Radiation Safety Authority) expert group since many years and the German SSK (Strahlenschutzkommission) expert group. The Swedish SSM 2021 report concluded that there is “no reason to change any reference levels or recommendations in the field”⁵⁰ and the German group adopted a report in December 2021 concluding in line with the industry beneficial narrative that “there is currently no reliable evidence for health risks from exposures of persons below” the ICNIRP limits. She was also member of SCENIHR 2015 working group, concluding that there was no evidence for health effects.

Olga Zeni: Previously funded by Telecom Italia⁵¹, Italy (wireless industry). She was also a member of SCENIHR 2015 working group, concluding that there is no evidence for health effects and the WHO 2014 expert group drafting sections. She has previously expressed opinions in favour of ICNIRP limits.⁵²

It is remarkable how the four appointed SCHEER working group members with expertise on RF biological effects all over the last years have expressed positions that benefit continued adherence to the ICNIRP limits, in conflict with the majority of experts in the field. Furthermore, three of them were also on the SCENIHR 2015 working group (Samaras, Danker-Hopfe, Zeni). Consequently, it is no

⁴³ <https://www.ices-emfsafety.org/wp-content/uploads/2017/01/SCC39-Annual-Report-2015-2016.pdf>

⁴⁴ <http://www.itis.ethz.ch/assets/Downloads/Annual-Reports/ITISReport2014web.pdf>

⁴⁵ https://ec.europa.eu/health/scientific_committees/scheer/docs/doi_scheer_samaras2016_en.pdf

⁴⁶ www.ncbi.nlm.nih.gov/pmc/articles/PMC7230863/

⁴⁷ <https://www.stralsakerhetsmyndigheten.se/contentassets/fce87121bd5e47ca95ad16d93d03f638/202108-recent-research-on-emf-and-health-risk.pdf>

⁴⁸ <https://www.stralsakerhetsmyndigheten.se/contentassets/fce87121bd5e47ca95ad16d93d03f638/202108-recent-research-on-emf-and-health-risk.pdf>

⁴⁹ <https://www.emf.ethz.ch/en/promotion/projects/list-of-funded-research-projects/>

⁵⁰ <https://www.stralsakerhetsmyndigheten.se/contentassets/fce87121bd5e47ca95ad16d93d03f638/202108-recent-research-on-emf-and-health-risk.pdf>

⁵¹ <https://www.emf-portal.org/en/article/10036>

surprise that the SCHEER opinion takes the same position as the SCENIHR opinion 2015 in its attitude. Two of the experts are also on the Swedish SSM expert group, where a majority of the experts always have been members or consulting experts of ICNIRP. Several of them also receive funding from the telecommunications industry. Consequently, SSM reports have consistently concluded in favor of ICNIRP limits. In 2011, it was revealed that a prominent member of SSM and previous member of ICNIRP 1996-2008 and SCENIHR 2009/2007 (A. Ahlbom) was a member of the board in his brother’s telecom lobbying company in Brussels. Furthermore, the brother had previously been a lobbyist for the largest Swedish telecom operator, Telia, in Brussels.

The outcome of the SCHEER report can be said to be predetermined, merely by the choice of experts on the working group. The result is given by design.

2.2 Closed Circle of Self-referencing – the ICNIRP Cartel

The SCHEER Opinion 2022 paper refers to ICNIRP 2020 and SCENIHR 2015 and frequently also to a report from the Health Council of the Netherlands (where ICNIRP’s chair 2020 Eric van Rongen is secretary). ICNIRP 2020 in turn refers to the Swedish expert group SSM 2015, 2016, 2018 in which Heidi Danker-Hopfe, Clemens Dasebrock, ICNIRP chair Eric van Rongen, and ICNIRP member Martin Rösli participated. Further, ICNIRP 2020 refer to WHO 2014 in which ICNIRP chair (Eric van Rongen) and vice chair (Maria Feychting) participated. Six of seven members of the WHO 2014 core group are tied to ICNIRP.⁵³ ICNIRP 2020 also refers to SCENIHR 2015. These relatively few ICNIRP-positive experts are referencing back and forth to each other in a closed circle. However, to most readers it appears as if many scientists from many different organizations agree. Figure 1 below gives examples of pro-ICNIRP experts from various expert groups that reappear in several other expert groups.

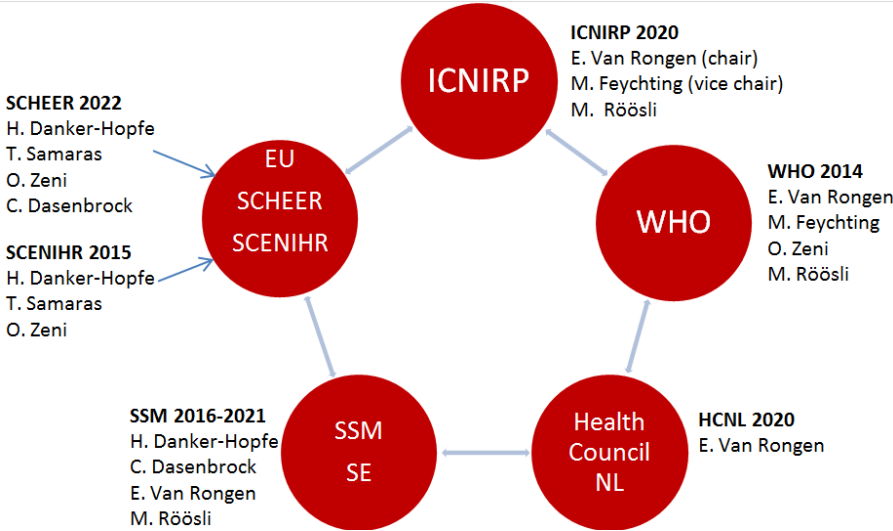


Figure 1. Closed circle: SCHEER, SCENIHR 2015, ICNIRP, WHO, SSM and Health Council of the Netherlands. Examples of same experts reappearing in several expert groups.

⁵³ Table 1 in www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html

Nordhagen and Flydal (2022) analyzed the composition of authors behind the reports on which the ICNIRP 2020 guidelines are based. Their analysis, published in 2022, shows that the authors of the ICNIRP 2020 guidelines paper are referring to themselves and their co-authors in a small circle of ICNIRP-affiliated co-authors, with only 17 researchers at its core: *“Our analysis shows that ICNIRP 2020 itself, and in practice all its referenced supporting literature stem from a network of co-authors with just 17 researchers at its core, most of them affiliated with ICNIRP and/or the IEEE, and some of them being ICNIRP 2020 authors themselves. Moreover, literature reviews presented by ICNIRP 2020 as being from independent committees, are in fact products of this same informal network of collaborating authors, all committees having ICNIRP 2020 authors as members.”*⁵⁴

Journalists from Investigate Europe did an investigation of ICNIRP’s influence on expert panels in 2019. Their report⁵⁵ showed the influence of ICNIRP on other important health protection organizations and concluded that there was an *ICNIRP cartel* of experts that influenced SCENIHR/SCHER and the WHO and other health agencies' conclusions on the topic.⁵⁶

The table below (Table 1) illustrates how many experts re-appear in several influential expert groups that evaluate the scientific evidence on health risks with RF radiation.

Being a member of ICNIRP is a potential conflict of interest when acting on behalf of another organization, according to a decision by the ethical council of the Karolinska Institute. This opinion was based on an analysis of Anders Ahlbom, member of both ICNIRP (1996-2008), SCENIHR (2009 and 2007) and SSM (2002-2011).⁵⁷

⁵⁴ <https://www.degruyter.com/document/doi/10.1515/reveh-2022-0037/html>

⁵⁵ <https://www.investigate-europe.eu/publications/how-much-is-safe/>

⁵⁶ <http://www.cqlpe.ca/pdf/5G-mass-experiment-ICNIRP-cartel-Investigate-Europe.pdf>

⁵⁷ https://ehtrust.org/wp-content/uploads/lettter-hardell-roosli-to-swiss-confederation-mrs.-sommaruga-reevaluation-of-safety-standards-icnirp-5g-berenis_uvek_january-2020.pdf

Table 1. The EU Commission working group experts on EMF 2007-2022

| SCHEER 2022 | SCENIHR 2015 | ICNIRP | IEEE/ICES | WHO 2014 | SSM | EMF Scientist Appeal |
|--------------------------|-----------------------------|---------------|------------------|-----------------|------------|-----------------------------|
| Theodoros Samaras | X | | X | | | |
| Heidi Danker Hopfe | X | | | | X | |
| Olga Zeni | X | | | X | | |
| Clemens Dasenbrock | | X | | | X | |
| Teresa Borges | | | | | | |
| Demosthenes Panagiotakos | | | | | | |
| Ana Proykova | | | | | | |
| Marian Scot | | | | | | |
| SCENIHR 2015 | SCHEER 2022 | ICNIRP | IEEE/ICES | WHO | SSM | |
| Theodoros Samaras | X | | X | | | |
| Norbert Leitgeb | | X | | | | |
| Anssi Auvinen | | X | | | - | |
| Heidi Danker Hopfe | X | | | | X | |
| Kjell Hansson Mild | | | | | | |
| Mats Olof Mattsson | | X | X | | | |
| Hannu Norppa | | | | | | |
| James Rubin | | | | X | | |
| Maria Rosaria Scarfi | | X | | X | X | |
| Joachim Schüz | | | | | | |
| Zenon Sienkiewicz | | X | | | | |
| Olga Zeni | X | | | X | | |
| SCENIHR 2009 | SCENIHR 2007 or 2015 | ICNIRP | IEEE/ICES | WHO | SSM | |
| Mats-Olof Mattsson | X | X | X | | | |
| Anders Ahlbom | X | X | | | X | |
| James Bridges | | | | | | |
| Eric van Rongen | | X | X | X | X | |
| Lena Hillert | X | | | | X | |
| Jukka Juutilainen | X | X | | | | |
| Georg Neubauer | X | | | X | | |
| Joachim Schüz | X | | | X | | |
| Myrtil Simkó | X | | | | | |
| SCENIHR 2007 | SCENIHR 2009 or 2015 | ICNIRP | IEEE/ICES | WHO | SSM | |
| Anders Ahlbom | X | X | | | X | |
| James Bridges | X | | | | | |
| Mats-Olof Mattsson | X | X | X | | | |
| René de Seze | | X | | | | |
| Lena Hillert | X | | | | | |
| Jukka Juutilainen | X | X | | | X | |
| Georg Neubauer | X | | | | | |
| Joachim Schüz | X | | | | | |
| Myrtil Simko | X | | | | | |

3. Comments on Various Chapters of the SCHEER Opinion Report

Below follow comments on different chapters of the SCHEER Opinion report.

3.1 Opinion (SCHEER report section 2)

SCHEER claims *“there is uncertain weight of evidence for interaction mechanisms in in vitro studies, involving oxidative balance, genetic and epigenetic effects, and calcium signaling, that can result in biological effects.”*

SCHEER further argues that they *“could not identify moderate or strong level of evidence for adverse health effects resulting from chronic or acute RF EMF exposure at levels below the limits set in the annexes of Council Recommendation 1999/519/EC and Directive 2013/35/EU”*, thus below the ICNIRP levels set in 1998.

SCHEER also claims that new wireless applications emit lower power in closer vicinity to the human body but that there are situations in which beam focusing or intense pulsed radiation can increase exposure for “short times”.

SCHEER further claims that the new ICNIRP 2020 recommendations could protect humans “more effectively” from emerging technologies (as 5G for instance).

SCHEER thus advises positively on the adoption of ICNIRP 2020 guidelines:

“The SCHEER acknowledges that the latest (2020) ICNIRP exposure guidelines introduce new dosimetric quantities and limits to them, that can protect humans more effectively from emerging technological applications of RF EMF, and, therefore, advises positively on the need of a technical revision of the annexes in Council Recommendation 1999/519/EC and Directive 2013/35/EU with regard to radiofrequency electromagnetic fields (100 kHz to 300 GHz).”

This opinion is in stark contrast to the available scientific evidence for harmful effects well below the ICNIRP limits and further makes it evident, as concluded in the section of conflicts of interests, that the outcome of the SCHEER report was predetermined by design, i.e., by the selection of experts that previously have expressed support for ICNIRP. Furthermore, there is no scientific evidence at all to support that the ICNIRP limits protect against harmful effects from RF chronic whole-body exposure from 5G, 4G, 3G or 2G base stations. On the contrary, there is solid, comprehensive evidence showing that the radiation causes oxidative stress in multiple organisms (see section 3.6) which is a likely mechanism for many of the observed health effects. Furthermore, comprehensive evidence of severe health effects from animal studies (eg. the NTP study, see section 3.9) proves the existence - beyond any doubt - that other (non-thermal) mechanisms causes health effects below the thermal threshold. Thus, the animal studies prove the thermal paradigm wrong. These proven facts support the findings of human health effects found in human studies from 2G, 3G and 4G (part of these studies are referenced in this report). The evidence on 5G is still very sparse, but the two first 5G-studies in humans reported that symptoms known as the microwave syndrome appeared rapidly after

deployment of 5G in previously healthy persons, suggesting that 5G may be even more biologically active than the previous technologies.^{58,59}

No doubt there is today clear and substantial evidence of harmful health and biological effects from RF-radiation at levels below the ICNIRP guidelines. The International Commission on Biological Effects from EMF (ICBE-EMF) and the EMF Scientists Appeal signed by 256 scientists on EMF have concluded that there is sufficient evidence to warrant lower limits in order to protect human life (see previous and following sections).

The Opinion by SCHEER is clearly favourable to the telecommunications industry's needs but detrimental to public health and the environment, ignoring the comprehensive scientific evidence of serious health effects.

3.2 SCENIHR 2015 (SCHEER report 4.2.1)

SCHEER relies on the SCENIHR opinion 2015, claiming that *“There were studies suggesting health effects of exposure, but these had not been replicated. Some theoretical mechanisms had also been proposed, but there was no experimental evidence for them.”*

Methodologically, it is not correct according to principles for risk assessment to rely on previous reports. All relevant scientific evidence (peer reviewed scientific studies) should be considered and evaluated together when performing a scientific assessment. Therefore, the references to the mere conclusions of previous reports (=not peer-reviewed science), without any critical assessment, is unscientific.

As explained in the previous section on conflicts of interests, three of the four SCHEER opinion authors were also on the SCENIHR 2015 opinion, thus SCHEER is referring to their own previous opinion, rather than scientific evidence.

Interestingly, the ICNIRP 2020 guidelines also rely on the very same SCENIHR opinion, which was clearly not an objective description of the scientific evidence available in 2015. The reason is that SCENIHR was also very biased in favor of the ICNIRP and telecommunications industry narrative that there are no health effects below ICNIRP guidelines. The majority of the working group members had ties to ICNIRP, IEEE, or the telecommunications industry in terms of research funding.⁶⁰

186 critical comments were submitted to EU on the SCENIHR 2015 report. Among these, The BioInitiative Group concluded: *“In summary, the preliminary SCENIHR conclusion that glioma risk is weaker now is not scientifically justified. The only way that conclusion could be reached by SCENIHR is to exclude critical studies that present evidence to the contrary, i.e., studies that report the risk of glioma (and acoustic neuroma) is stronger now than in 2009”.*

A coalition of 20 NGO's also sent this critique to the EU Commission: *“We call for a new balanced assessment that better meets the Commission's own principles. A new balanced and objective report,*

⁵⁸ https://www.gavinpublishers.com/assets/articles_pdf/Case-Report-The-Microwave-Syndrome-after--Installation-of-5G-Emphasizes-the-Need-for--Protection-from-Radiofrequency-Radiation.pdf

⁵⁹ <https://www.anncaserep.com/open-access/development-of-the-microwave-syndrome-in-two-men-shortly-after-9589.pdf>

⁶⁰ www.stralskyddsstiftelsen.se/wp-content/uploads/2015/09/Annex_1_SCENIHR_Experts_2015.pdf

without the influence from industry biased experts, is urgently needed if the Commission does not want to continue to put Public Health at serious risk by policies based on incomplete, severely biased and false information. The SCENIHR report, as it stands, is a disservice and a threat to the health and well-being of the people of Europe”⁶¹

The very same year 2015, the EMF Scientist Appeal, was launched, today signed by 256 EMF scientists. These scientists, authors of more than 2000 peer-reviewed papers in the EMF research field, conclude:

“Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.”

SCHEER writes that SCENIHR concluded that results of epidemiological studies on mobile phone users did not show an increased risk of brain tumors nor cancers in the head and neck region. Further, that *“cohort and incidence time trend studies did not support an increased risk for glioma at that time (2015), while the possibility of an association with acoustic neuroma remained open. Epidemiological studies did not indicate increased risk for other malignant diseases, either, including childhood cancer”*.

This statement was falsified by Hardell et al. (2021), in a critical review of the ICNIRP 2020 guidelines,⁶² concluding *“The conclusion of no brain tumor risks from RF radiation relied upon several studies with methodological shortcomings resulting in underestimated risks....*

In conclusion, SCENIHR did not do what they were required to do, i. e., an assessment of potential health risks, but required absolute proof and mechanistic evidence of EMF risks i.e., SCENIHR assessed if a health effect was (completely) established or not. As stated by Sage et al. (2016):

“The review as written would be better titled: “Opinion on scientific certainty of health harm from electromagnetic fields [...] Overall SCENIHR has not conducted a scientific review process for judging potential health risks. This results in erroneous and deceptive conclusions by failing to conclude such risks do exist. The evidence that SCENIHR has presented clearly and conclusively demonstrates that EMF health risks are possible and in some cases are established”.

Note also this important distinction set forward by Sage (2016): *The implementation of the precautionary principle does not require absolute proof and mechanistic evidence. On the contrary – when there is absolute proof, protection limits can be set to prevent from public health harm, without implication of the precautionary principle. The precautionary principle is to be applied when there is sufficient evidence that there is a probable risk to the environment and public health, and when the consequences of such effect would have a major importance for public health, e.g., when large part of*

⁶¹ www.stralskyddsstiftelsen.se/wp-content/uploads/2015/09/Complaint_European_Commission_SCENIHR_2015-08-31.pdf

⁶² www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html

the public and the environment are exposed to potential danger. This is exactly the case for RF EMR, as pointed out by the EEA already in 2009.

3.3 ICNIRP 2020 – (SCHEER report 4.2.2)

These are quotes from the SCHEER report on ICNIRP 2020 guidelines:

- *“No reports of adverse effects of RF EMF exposures on symptoms and wellbeing have been substantiated,”*
- *“No consistent evidence of effects (hormones) has been observed”*
- *“No effects of RF EMF on the induction or development of cancer have been substantiated.”*
- *“Some studies have reported effects on male fertility ...but these studies have had methodological limitations.”*
- *“Some epidemiological studies have reported associations between RF EMF and sperm quality or male infertility, but these studies suffer from limitations in study design or exposure assessment.”*
- *“The few epidemiological studies performed about maternal mobile phone use during pregnancy have not shown any substantiated evidence.”*
- *“Most studies indicate that there are no effects on endpoints regulated by the autonomic nervous system.”*
- *“It has been reported that exposure to pulsed RF EMF increased neuronal death in rats, which could potentially contribute to an increased risk of neurodegenerative disease. However, other studies have failed to confirm these results.”*

Furthermore, SCHEER quotes ICNIRP stating that the radiation might even protect against severe diseases:

“A cohort study has investigated potential effects of mobile phone use on neurodegenerative disorders. It reported reduced risk estimates for Alzheimer disease, vascular and other dementia, and Parkinson disease”

The reference to these findings, which is quoted uncritically, is a clear example of ICNIRP’s double standards: If there is no mechanism causing biological effects below the thermal threshold, how is the radiation supposed to be able to protect against disease at these levels? The cohort study⁶³ referred to is well-known to have severe problems of misclassification of exposure, and consequently the conclusion regarding “protective” effects is false.

When SCHEER refers uncritically to ICNIRP 2020 as background scientific assessment, it follows automatically that the evaluation will be biased in favor of the ICNIRP 2020 and 1998 guidelines.

As mentioned in previous sections, the vast majority of scientists today agree that ICNIRP limits allow for harmful exposure.

Biased methodology behind ICNIRP guidelines

63 <https://pubmed.ncbi.nlm.nih.gov/19194493/>

I. ICNIRP concludes that the ICNIRP guidelines provide sufficient protection on human beings, and that technologies are perfectly safe when the RF radiation is below the ICNIRP exposure limits, although there are no scientific studies at all showing that chronic exposure to 5G, 4G or 3G base station radiation at ICNIRP levels do not cause harmful effects in humans. In 2020, ICNIRP's chairman Eric van Rongen made a claim that exemplifies this unscientific attitude:

"The most important thing for people to remember is that 5G technologies will not be able to cause harm when these new guidelines are adhered to,"⁶⁴

The methodology used to arrive at that conclusion is to systematically raise doubts on scientific evidence of harmful effects below the ICNIRP guidelines and demanding an unrealistic level of proof of harmful effects (much in conflict with the recommendations from the EEA). The required level of proof is described in subjective terms as "substantiated", "independently verified", "sufficient quality" and "consistent with current understanding", and ICNIRP is using their own definition of "evidence":

"The ICNIRP bases its guidelines on substantiated adverse health effects, which are different from biological effects. The ICNIRP considers that reported adverse effects of RF EMF health need to be independently verified, be of sufficient scientific quality and be consistent with current scientific understanding in order to be used for setting exposure restrictions. Within the guidelines, "evidence" will be used within this context, and "substantiated effect" used to describe reported effects that satisfy this definition of evidence."

ICNIRP discard the vast majority of the science essentially in three manners:

1. ICNIRP bases the guidelines on so-called "substantiated adverse health effects, which are different from biological effects". Hereby, ICNIRP discards a huge number of highly relevant studies showing biological effect on cells, animals and humans. ICNIRP chooses to ignore that many biological effects are precursors for disease or even indicators for disease, such as oxidative stress, DNA damage, and disturbance of transport of molecules across the cell membrane. Furthermore, ICNIRP ignores that such studies are indeed evidence that mechanisms affecting living cells do exist below the thermal threshold – i.e., evidence of mechanisms that ICNIRP assumes does not exist.

Furthermore, studies showing biological effects substantiate the finding of (related) health effects in other studies. As Munafò and Davis wrote in Nature ⁶⁵: *Robust research needs many lines of evidence. Replication is not enough". "Consistent findings could take on the status of confirmed truths, when they actually reflect failings in study design, methods or analytical tools."* The only way to reveal this type of error is to use multiple approaches: *"Results that agree across different methodologies are less likely to be artefacts."*

2. Based on the subjective criterion "substantiated health effects" and "consistent with current scientific understanding", ICNIRP discards the vast majority of scientific studies showing effects below the thermal threshold. Because mechanism of the non-thermal effects are not clarified completely, ICNIRP consider the all observed effects below the thermal threshold to be "unsubstantiated" and not "consistent with current scientific

⁶⁴ <https://www.inverse.com/input/tech/scientists-rule-5g-is-safe-surprising-no-one-except-the-tinfoil-hat-brigade>

⁶⁵ www.nature.com/articles/d41586-018-01023-3

understanding". This ICNIRP approach is unscientific: If science was to accept only findings that are in consistence with current scientific understanding, scientific progress would be severely inhibited: Einstein's findings would never have been acknowledged (not being in accordance with Newton's laws), and the existence of microbes and the significance of hand washing would not have been acknowledged in the 19th century. These examples are both discoveries of enormous importance to humanity. Important studies, such as the NTP study on rats, show without doubt that mechanisms causing health effects in mammals indeed do exist. Therefore, such mechanisms also exist in humans (regardless of whether studies show that the radiation causes measurable disease), and consequently, the ICNIRP guidelines do not protect against potential long-term effects.

3. ICNIRP demands exact replication of studies before even considering them as "evidence". Hereby, ICNIRP automatically discards most of the evidence-base, as most independent researchers cannot get funding for replications. Taking into consideration only the few replicated studies (weighing them above other studies), there is a real risk of repeating design flaws and weaknesses of those studies, cementing them as truths.

As ICNIRP concludes that there cannot be health effects except for those arising due to heating, their selection of study confirms that only thermal effects are substantiated – securing that ICNIRP's limits are maintained. When ICNIRP claims that there is "no evidence" for effects below the thermal threshold, they refer to their own false definition of "evidence". Furthermore, the demand for replication actually increases the risk of false "confirmed truths" – such as the thermal paradigm. Finally, when ICNIRP fails to include studies with multiple approaches, such as studies showing biological effects, ICNIRP is more likely to make false conclusions.

3.4 Scientific methodology (SCHEER report 4.1)

Selection of scientific studies

In the opinion report, SCHEER has relied on the *Memorandum on Weight of Evidence and uncertainties* (SCHEER, 2018).

Regarding the selection of scientific studies SCHEER states: "*The SCHEER has considered meta-analyses, systematic reviews, and, when necessary, narrative or scope reviews and single research papers published after and including 2015 on radiofrequency electromagnetic fields (100 kHz to 300 GHz).*"

This approach is both insufficient and biased.

- Firstly, SCHEER relies mainly on a few review reports (most are not peer-reviewed scientific reviews) from expert groups with a predetermined bias towards the ICNIRP limits, the closed circle, as explained in the conflicts of interest chapter – the ICNIRP cartel. This forms the ground for biased conclusions.
- Secondly, not all systematic reviews after 2015 are included – and most systematic reviews before 2015 are excluded.
- Thirdly, the criterion "when necessary" is both subjective and unscientific, and not further qualified.

Regarding the methodology SCHEER states: *“The scientific assessments carried out should always be based on scientifically accepted approaches, and be transparent with regard to the data, methods and assumptions that are used in the risk assessment process.”*

The SCHEER report clearly does not fulfill the criteria pointed out by SCHEER themselves:

1. The criterion “when necessary” is not at all clear/transparent or a scientifically accepted approach. The unscientific approach is further aggravated by the fact that “when necessary” does not mean including good quality studies showing effects. On the contrary, such studies are excluded (see for example the section on cardiovascular effects and the section on Neurological and neurobehavioral animal studies) – while other low-quality studies that are not reporting effects are included, thus judged “necessary” (e.g., the uncritical inclusion of Schüz et al. (2022), see Section 3.8).
2. The criteria for selecting reviews and meta-analysis are not clear. For example, some reviews (not peer reviewed, e.g., the review published by the Dutch Authorities) are included, while some scientific reviews (peer reviewed) from the same period are not. In contrast, several systematic, peer-reviewed reviews showing significant effects are not included by SCHEER, e.g., Yakymenko et al, 2016⁶⁶; Miller et al. 2019⁶⁷; Panagopoulos, 2019⁶⁸; Belpomme and Irigaray, 2022¹³².

When performing a scientific assessment (hazard identification in risk assessment), all scientific evidence should be considered. Therefore, it is a serious bias when SCHEER excludes all scientific evidence dating earlier than 2015, and ignores the importance of this science, merely based on conclusions in a few reports (not peer reviewed) that are contradicted by many other scientific reviews by other groups of scientists. Firstly, because it is based on an assumption that the previous reports are perfect (flawless and exhaustive). Secondly, and importantly, even if parts of the evidence were not sufficient when evaluated separately, it may be sufficient for concluding on effects, when taken together with later evidence in the field.

In conclusion, the SCHEER group is clearly biased in the selection of studies.

Criteria for evaluation of the science

SCHEER refers to the SCHEER document *Memorandum on weight of evidence and uncertainties* (Revision 2018), in which it is stated:

“For each line of evidence, the criteria of validity, reliability and relevance need to be applied and the overall quality has to be assessed.”

However, SCHEER does not clarify which criteria for validity or reliability have been applied in the draft report, or how they have decided upon relevance. It appears that the criteria are varying, and the criteria are not at all justified in the report.

When evaluating the science, it is pertinent to look for systematic differences between studies finding effect vs. the “no-effect” studies. Such systematic differences are related to the demand of “relevance”.

⁶⁶ <https://pubmed.ncbi.nlm.nih.gov/26151230/>

⁶⁷ <https://pubmed.ncbi.nlm.nih.gov/30196934/>

⁶⁸ <https://pubmed.ncbi.nlm.nih.gov/31416578/>

Furthermore, it is also important to take into account the possible conflict of interest in terms of source of funding of the research that might have impacted the results reported. Huss et al 2007 concluded that *“Studies funded exclusively by industry reported the largest number of outcomes, but were least likely to report a statistically significant result”*, and that *“The interpretation of results from studies of health effects of radiofrequency radiation should take sponsorship into account”*⁶⁹

SCHEER has failed completely in these regards.

Both in epidemiological studies and in experimental studies it is pertinent to ensure that the exposure is relevant and sufficient – and that the control group is not exposed (see comments on the sections "Symptoms" and "Neoplastic diseases" (subsection Epidemiology)).

In the evaluation of RF radiation, IARC (2011) stated that the carcinogenic effect depends on the intensity and the duration of the exposure. Since then, it has been evidenced that the modulation (time-variation of the amplitude) of the radiation as well as the particular frequencies and intensities used are also of major importance (Panagopoulos, 2019; Lai, 2021). SCHEER refers to the review by Lai (2021) that documents the importance of modulation for the effects on DNA. Nevertheless, SCHEER completely fails to scrutinize the included studies regarding these major issues: Whether the RF -modulation ("pulsing") is relevant, and represent real life exposure (i.e. modulation similar to those used in telecommunication devices and base stations), or whether radiation generators producing sine-waves (non-pulsed, continuous carrier waves) have been applied. Studies applying the latter radiation type (sine-waves) are not relevant to evaluate real-life exposure health effects and should be excluded.

In contrast, SCHEER discards an important part of the studies, because dosimetry (=measurement of the amount of radiation energy, i.e., a function of intensity and duration) has not been applied, or the dosimetry is deemed “incomplete” by SCHEER. As this report aims at hazard identification, not on dose-response determination, it is simply unscientific to discard studies merely based on this criterion “dosimetry” in this report. Exact dose-response determination is not necessary in hazard identification (see EEA reference in footnote 34). What is important is that the exposure is relevant and sufficient.

There are other - more relevant - criteria to ensure that the exposure is relevant and sufficient. For example, the exposure with mobile phones in talk mode is a relevant exposure, as it mimics real-life exposure better than simulated exposure arrangements, - even if dosimetry has not been used. Dosimetry is by no means an essential criterion for the hazard identification, except in studies not finding effect because the lack of effect may be due to insufficient exposure. Of relevance to a hazard identification, a vital criterion would be to ensure that the exposed group is in fact exposed to the relevant radiation, and the control group is not exposed.

It should be noted that most studies using complete dosimetry are using un-modulated sine-waves – which are known to have little if any biological effects below ICNIRP thermal threshold. In this manner, SCHEER endorses most studies which are using irrelevant exposure, and exclude a large part of the studies using relevant exposure based on the demand for “dosimetry”. This is grossly unscientific.

Regarding epidemiological studies on cancer, SCHEER “weighs” results on long term exposure and highest exposure groups together with those on short term and low exposure, reaching the

⁶⁹ <https://pubmed.ncbi.nlm.nih.gov/17366811/>

conclusion that there is weak evidence. By “weighing” studies with relevant exposure (long term, highest user group) together with studies with irrelevant exposures for cancer risk evaluation (short term low user groups), SCHEER disguises, that there is strong evidence for the effect of high exposure to mobile phone radiation: There is strong evidence that long term exposure for the highest user category and over ten years of exposure (i.e. over approximately 30 minutes/day for at least ten years) causes increased risk of brain cancer. All the included meta-analyses support this effect. Thus, the methodology applied by the SCHEER is both unscientific and misleading.

In summary, the SCHEER evaluation of the scientific studies is severely biased and/or un-scientific:

- SCHEER fails to acknowledge the important systematic differences between studies finding effect vs. the “no-effect” studies. Such systematic differences are related to the demand of “relevance” of exposure. In particular, SCHEER ignores the importance of modulation as opposed to sine-waves.
- SCHEER is misleading when using the criterion regarding dosimetry to discard experimental studies, showing a causal relationship between RF- EMR exposure and health effects,
- SCHEER endorses cancer studies with too short latency and too low exposure and fails to note that this is a likely explanation why the studies do not find effects.
- SCHEER discharges studies that find effect from relevant and sufficient exposure compared to real unexposed control groups [e.g., see section on cardiovascular effects].

Evaluation of the “Weight of Evidence”

SCHEER refers to the SCHEER report from 2018 regarding the methodology for “weighing the evidence”. The described methodology simply “counts” the number of (included) studies finding effects against the number of studies not finding effects. This is not a scientifically established method:

In all lines of biological and medical research there will always be studies that do not find effect, but this is not proof that there is no effect. Even if a large part of the studies does not find effect, it is not a proof of “no effect”, but may simply represent a large number of studies with flawed methodology (e.g. section on “symptoms”).

Applying the SCHEER methodology on e.g., smoking, would render the evidence on health effects of smoking “very weak”. Producing flawed “no-effect” studies and ensuring that these are weighed equally to studies finding effects is the method the tobacco industry used for decades to protect their products, as described in the EEA report “Late lessons from early warnings” (2013)⁷⁰. Now SCHEER is using this methodology on RF-EMR.

Regarding the RF radiation research, the scientific evidence of negative biological effects and health effects is overwhelming. However, the term “inconsistency” is abused in this report to produce doubt about the effects and conclude that the evidence is weak – or even that there is “no evidence”. In natural science, the criteria for deeming the findings (statistically) significant ensure that only if the evidence is very strong (more than 95% or 99% certainty of effect) the findings are deemed “significant”. For example, if the correlation between exposure and disease was “only” 80%, the finding would be deemed “insignificant”, and it would be concluded that no correlation was found.

⁷⁰ www.eea.europa.eu/publications/late-lessons-2/late-lessons-2-full-report/late-lessons-from-early-warnings/view

This is not at all the same as “proof of no effect”. Therefore, studies not showing effect can never be interpreted as “proof” of “no effect”. Especially not when other studies have shown effect.

It is unscientific and misleading, when SCHEER concludes that the evidence is weak merely based on the occurrence of studies not finding effects, and despite the evidence in numerous studies finding negative biological effects or health effects from the exposure to RF radiation.

For some effects, SCHEER even goes as far as to conclude that there is *strong evidence* for “no-effect”, in spite of numerous studies showing effect (e.g., in chapter on effect on cardiovascular system) - this is clearly highly unscientific and misleading and yet another example of SCHEER’s biased and non-objective attitudes.

3.5 Emerging Technologies (SCHEER 5.1)

SCHEER Conclusion

Regarding the new 5G technology SCHEER writes (page 17): “[...] i.e., higher maximum output power and dynamic pencil beam 22 forming with a larger number of antenna elements. The maximum transmitted power by 23 a 5G BS (Base station) can reach up to 200 W, almost double the corresponding value for a 4G BS.”

SCHEER further writes: “Since the radiation pattern with massive MIMO varies over time and space, traditional assessment of compliance procedures to quantify the exposure can be misleading. These classical methods rely on conservative assumptions, e.g., all the users are in the same location that coincides with the testing point.”

Our Critique and Conclusion

The increase in intensity and formation of ultrahigh intensity beams rightfully cause concerns in the public and the scientific community. The first 5G study confirmed the concerns expressed by many scientists that 5G leads to a massive increase in RF exposure and that this increase led to rapidly developed symptoms of the microwave syndrome.⁷¹ Furthermore as mentioned previously there are no studies at all showing that 5G base station radiation exposure does not cause disease in humans.

SCHEER is highly misleading, because the variation in radiation pattern with MIMO does not change the fact that the beams reach very high intensities (corresponding to a factor 1000 higher than mobile phones). These beams might cause acute damage to sensitive tissues and ocular corneal damage from short term exposure at comparable exposure levels⁷². Even though the described corneal damage is partly reversible by a healing process, healing will not succeed, if the damage occurs repeatedly. Furthermore, when such damage from beam exposure occurs to other tissues which cannot regenerate, e.g., the eye retina and ovaries, the consequences over time would be devastating (sterility and blindness) for large parts of the population.

The statement that the "classical methods" assumes “that all users are in the same location” (i.e., the same test point) is completely nonsense: The exposure limits should protect each individual,

⁷¹ https://www.gavinpublishers.com/assets/articles_pdf/Case-Report-The-Microwave-Syndrome-after--Installation-of-5G-Emphasizes-the-Need-for--Protection-from-Radiofrequency-Radiation.pdf

⁷² <https://link.springer.com/article/10.1007/s10762-018-0497-z>

including those passing through beams from the MIMOs connecting to nearby mobile phones. The statement from SCHEER suggests that lowering of the exposure limits is only warranted, if there is evidence that all people will be damaged from the new technology.

The fact is that in large crowds (e.g., at concerts or football stadiums), many individuals will be exposed to multiple cross field exposure over extended periods, causing even higher exposures than in a single beam.

SCHEER proposes to change the dosimetry using stochastic methods, thus solving the problem for the industry. That is, using exposure averages over 6 or 30 minutes in the simulation of the exposure, and thus ignore that the beams might cause rapid acute, thermal damage.

SCHEER is here clearly bending the interpretation of scientific evidence and dosimetric methods in favour of the industry, prioritizing the interest of the industry over public safety.

3.6 Oxidative Stress (SCHEER section 5.2.2)

SCHEER Conclusion

“The current scientific evidence, based on the narrative reviews, suggests that the cellular oxidative balance may likely be affected, although its correlation with possible adverse effects is not clear. ..there is no consistent evidence of biological effects involving oxidative balance, genetic and epigenetic effects, and calcium signaling that can support and strengthen the evidence from epidemiological and in vivo studies on RF exposure”

Our conclusion

The chapter on oxidative stress is not an objective presentation of available evidence. There is by now very strong evidence that RF-radiation below ICNIRP limits causes oxidative stress, and that prolonged oxidative stress from RF EMF can cause health effects at exposure relevant for real-life exposure. But SCHEER spreads doubt over the scientific evidence. Further SCHEER mainly refers to a report by Schuermann and Mevissen, however, SCHEER's conclusion is much in contrast to the conclusions in the same study - thus, demonstrating the strong bias of the SCHEER report.

Background for our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion

The vast majority of studies show evidence of oxidative stress, but SCHEER leaves out publications documenting this: In 2018, Bandara et Weller⁷³ reported that *"242 RF-EMR studies that investigated experimental endpoints related to oxidative stress (OS) were identified. A staggering 216 (89%) of them found significant effects related to OS, similar to a previous review."*

In 2022, The BioInitiative Group updated the list of studies showing oxidative stress effects from RF-EMF exposure. The list compiled by Professor Henry Lai⁷⁴ showed that 91%, or 263 of 288 studies, published since 1990, reported significant effects related to oxidative stress.

SCHEER acknowledges that RF-EMF can lead to ROS formation and oxidative stress *“The trend the authors evidenced is that, even at low dose exposure, RF can affect cellular oxidative balance”*, but fails to acknowledge the comprehensive evidence of the consequences to health from prolonged oxidative stress, even though the evidence is given in the cited review (Schuermann and Mevissen, 2021)⁷⁵.

SCHEER presents a Swiss study by Schuermann and Mevissen (2021), as the most comprehensive review to date. SCHEER claims that Schuermann and Mevissen *“pointed out that some studies were subjected to methodological uncertainties or weakness or were not very comprehensive regarding exposure time, SAR level, number and quantitative analysis of the endpoints analysed”*.

However, SCHEER leaves out that just prior to this passage quoted, Schuermann and Mevissen write that overall, the evidence for oxidative damage in several organs was consistent (p235, see the citation further below), and directly afterwards:

“A trend is emerging, which becomes clear even when taking these methodological weaknesses into account, i.e., that EMF exposure, even in the low dose range, may well lead to changes in cellular

⁷³ <https://journals.sagepub.com/doi/10.1177/2047487317734898>

⁷⁴ <https://bioinitiative.org/research-summaries/>

⁷⁵ <https://pubmed.ncbi.nlm.nih.gov/33917298/>

oxidative balance. Organisms and cells are able to react to oxidative stress, and many observations after EMF exposure point to an adaptation after a recovery phase. Adverse conditions, such as diseases (diabetes, neurodegenerative diseases), compromise the body's defense mechanisms, including antioxidant protection mechanisms, and individuals with such pre-existing conditions are more likely to experience health effects. The studies show that very young or old individuals can react less efficiently to oxidative stress, which of course also applies to other stressors that cause oxidative stress."

SCHEER also indicates that the same review article concluded that there is an "adaptive process" to these effects and SCHEER therefore concludes "thus not leading to health effects". This is highly misleading and again a clear sign of bias, because SCHEER ignores that this "adaptive process" is only relevant, if the agent causing oxidative stress is short-termed, discontinued and not prolonged as in real-life. Thus, the adaptive process is irrelevant for the real-life exposure in humans, as a large part of the population is exposed close to 24 hours, 7 days a week. This is substantiated by the animal studies referenced:

Schuermann and Mevissen quote an extensive rat study concluding: "*the capacity of the antioxidative protection system was exhausted*" (p. 5). This exhaustion occurred after medium-term exposure of two hours exposure for 6 months, i.e., much less than the exposure of the general human population. They continue "*These results indicate that oxidative stress induced by RF-EMF can lead to DNA damage in neurons during prolonged exposure of the animals. Virtually identical results were also found in several other studies*" (section 3). The exposure in these studies were well below the ICNIRP guidelines.

In conclusion, the animal studies show that the RF-EMF exposure leads to ROS formation at real life exposures; when the exposure is prolonged, the protective mechanism is exhausted leading to oxidative stress, and eventually to serious health effects and chronic diseases, evidenced by increases in biochemical indicators of DNA and tissue damage "*damage to the DNA were associated with prolonged exposure over weeks or months, applied in many cases only for a few hours per day [29–34].*" (p11)

Schuermann and Mevissen concluded that "*investigations in Wistar and Sprague-Dawley rats provided consistent evidence for oxidative stress occurring after RF-EMF exposure in the brain and testes and some indication of oxidative stress in the heart. Observations in Sprague-Dawley rats also seem to provide consistent evidence for oxidative stress in the liver and kidneys. In mice, oxidative stress induced by RF-EMF was predominantly demonstrated in the brain and testes, as well as in liver, kidneys, and ovaries. These observations were made with a variety of cell types, exposure times, and dosages (SAR or field strengths), within the range of the regulatory limits and recommendations.*" (p 23).

Even though SCHEER mainly refers to Schuermann and Mevissen, SCHEER's conclusion is much in contrast to the conclusions in the same study: SCHEER completely ignores that there is strong, consistent evidence - from studies using many types of tissues, animals and exposures - of oxidative stress and consequent DNA damage, disturbance of cell function – and consequent health effects.

3.7 Genetic and Epigenetic Effects (SCHEER section 5.2.2)

SCHEER Conclusion

“In conclusion, there is no consistent evidence of biological effects involving oxidative balance, genetic and epigenetic effects, and calcium signalling that can support and strengthen the evidence from epidemiological and in vivo studies on RF exposure”

Our Conclusion

There is abundant evidence that RF radiation causes genetic effects. Taking the relevant exposure parameters into consideration, the evidence on oxidative stress and DNA damage is so massive and consistent that genotoxicity should be considered an established effect – or as a minimum, the evidence is sufficient for immediate decrease of the exposure limits to the lowest possible level.

Background for our conclusion and a critical evaluation of the SCHEER assessment and conclusion

According to a review from Professor Henry Lai⁷⁶, 291 studies published during the period 1990-2022 have shown genetic effects from RF exposure. That represents 68% of all 423 studies that examined genetic effects from RF exposure. In conclusion, the majority of studies show these effects. One example is the REFLEX study, funded by the EU, involving 13 laboratories in different European countries. Already by 2004, this REFLEX study showed DNA-damage occurring in human cells exposed to RF radiation. The Final Report concluded that the results *“indicate a genotoxic action of RF-EMF in various cell systems.”* The DNA damage (single and double strand breaks) was dependent on the duration of exposure, the field strength and the types of RF signals. The DNA-damage was a result from oxidative stress induced by RF and occurred at levels below the ICNIRP limits.⁷⁷ Furthermore, the evidence for DNA damage has been found more consistently in animal and human (*in vivo*) studies than in studies of cell cultures (*in vitro*).⁷⁸

SCHEER in the opinion report states: *“there are no systematic reviews available in the period of interest of this Opinion”*, leaving out several important studies and relevant reviews. Furthermore, the quotation of the studies is misleading.

SCHEER here also overlooks the review from Schuerman and Mevissen (2021) (quoted in the section on oxidative stress). Schuerman and Mevissen (2021) is a review on both oxidative stress and evidence on the associated health effects, including DNA damage.

The evidence of disturbed oxidative balance and prolonged oxidative stress is highly relevant, as one of well-known and established consequences of prolonged oxidative stress is DNA damage. In fact, even the DNA damage from ionizing radiation is to a high degree due to oxidative stress rather than from DNA knock-out effect from photons: *“The mechanism of deleterious ionizing radiation action is strongly associated with increasing oxidative stress in irradiated tissues”* (Nuszkiewicz et al., 2020)⁷⁹. Similar effects are associated with the oxidative stress resulting from RF-EMR:

⁷⁶ <https://bioinitiative.org/research-summaries/>

⁷⁷ https://www.irseco.com/wp-content/uploads/REFLEX_Final_Report_Part_3.pdf

⁷⁸ www.saferemr.com/2018/02/effects-of-exposure-to-electromagnetic.html

⁷⁹ www.ncbi.nlm.nih.gov/pmc/articles/PMC7460937/

The association between oxidative stress and DNA damage is so strong that DNA degradation can be used as an indicator for the formation of ROS and oxidative stress in vivo. Schuermann and Mevissen (2021) write: (P 4): “.... damage to biomolecules or their degradation products can be detected, especially as indicators for sustained oxidative stress. An increase in oxidized bases in the DNA (i.e., 8-oxo-G/8-OHdG) and the carbonylation of proteins serve as surrogate markers for ROS. Malondialdehyde (MDA), a degradation product of unsaturated fatty acids, is also a frequently analyzed biomarker for oxidative stress [27].” “MDA itself is highly reactive and can lead to structural changes and damage to DNA and proteins.”

Studies showing ROS and evidence for DNA damage in the brain consistently show DNA damage, as a consequence of prolonged oxidative stress from RF-EMR exposure:

Schuermann and Mevissen, Page 5: “In a comprehensive work with SpragueDawley rats, increased ROS activity or formation of MDA, 8-OHdG, and serum nitrite was observed after 6 months of RF-EMF exposure at different frequencies (900, 1800, and 2100 MHz) for 2 h per day [29]”. “the capacity of the antioxidative protection system was exhausted as the measured antioxidative markers were significantly lower compared to sham-exposed animals [29]. These results, indicate that oxidative stress induced by RF-EMF can lead to DNA damage in neurons during prolonged exposure of the animals. Virtually identical results were also found in several other studies [30–34].”

SCHEER states: “From recent narrative review papers, it appears that results are mainly inconsistent, with many experimental (in vitro and in vivo) studies showing significant genotoxicity and others reporting absence of an effect from RF exposure at intensities similar to those in the public environment. The effects, when present, are a function of frequency, amplitude, and modulation, and in most cases are not replicated in follow-up studies. (Lai, 2021; Karipidis et al., 2021; Kocaman et al., 2018; Jagetia, 2022). “

This statement is a misinterpretation: Lai (2021)⁸⁰ stresses that the modulation is very important for the genotoxicity. However, the modulation of the included studies is ignored in the other reviews, and many of the included studies used sinusoidal signals (=irrelevant exposure) which does not reflect real-life exposure. Thus, the modulation is one of several likely causes for the claimed “inconsistency” of the results. The importance of modulation is further stressed by the review of Panagopolous (2019), *Comparing DNA damage induced by mobile telephony and other types of man-made electromagnetic fields*⁸¹. This highly relevant study was also omitted by SCHEER. The review concludes: “While ~50% of the studies employing simulated exposures do not find any effects, studies employing real-life exposures from commercially available devices display an almost 100% consistency in showing adverse effects [34–36,84,100–118]”

SCHEER adheres to only one meta-analysis, which has investigated the association between genotoxic outcome and four quality measures (Vijayalaxmi & Prihoda, 2019)⁸². However, that study did not include one of the most important quality measures: using modulated RF exposure, nor was duration of exposure considered. Vijayalaxmi & Prihoda found that studies which fulfilled all of 4 “quality measures” did not show consistent genotoxic effect. However, one of the so called “quality measures” was strict dosimetry (which is not highly relevant), while the more important quality measure (modulation) was ignored. Due to irrelevant quality criteria, truly good quality studies were

⁸⁰ <https://pubmed.ncbi.nlm.nih.gov/33539186/>

⁸¹ <https://pubmed.ncbi.nlm.nih.gov/31416578/>

⁸² <https://pubmed.ncbi.nlm.nih.gov/30339042/>

excluded (merely due to lack of full dosimetry, i.e. using other quantitative measures for exposure), while other irrelevant studies (low quality using irrelevant exposure) were included, and consequently the results of Vijayalaxmi & Prihoda (2019, published in Radiation Research) are severely misleading. Vijayalaxmi has conflicts of interests in terms of previous funding by U.S. Air Force.⁸³ Again SCHEER fails to acknowledge that the majority of industry-funded studies do not report negative effects and that source of funding should be taken into account when evaluations of the results are performed⁸⁴: “80% of the negative papers (17 out of 21) published in Radiation

In conclusion, SCHEER ignores:

- The mutagenic effect of free radicals in relation to persistent oxidative stress is a proven mechanism responsible for DNA damage and there is consistent evidence of RF radiation causing oxidative stress at relevant exposures.
- The consistent evidence showing DNA damage in high quality-controlled animal studies, in relation to long term oxidative stress.
- The importance of modulation and polarization of the radiation for the genotoxic effect.
- Variation in duration and modulation of the exposure is causing the claimed “inconsistency” of results.
- Industry funding influence on results

The vast majority of studies not finding genotoxic effects have used irrelevant RF-EMR exposure, i.e., short term exposure and/or more importantly RF radiation which is not modulated (as by telecommunication devices). Furthermore, many of these no-effect studies were funded by the telecommunications or the military industry.

SCHEER fails to acknowledge these important facts, despite the quotation of Lai (2021).

3.8 Neoplastic Diseases - Epidemiology (SCHEER section 5.3.1.1)

SCHEER Conclusion

“Regarding carcinogenicity in humans, based on the available information provided in meta-analyses, and individual studies, the weight of evidence for adverse health effects from exposure to RF EMF is uncertain”.

Our conclusion

The majority of the meta-analyses based on epidemiology support the fact that the radiation from mobile phones is associated with brain cancer, and the fact that most of the studies mentioned showing no-effect have serious and obvious methodological flaws. SCHEER chooses to ignore that meta-analyses on mobile phone use and cancer risks nearly consistently show significant increased risk of brain tumours from long term use of mobile phones in the most exposed groups, which are the groups where increased risks are first expected to be discovered.

⁸³ <https://microwavenews.com/news-center/journals-address-conflicts-interest>

⁸⁴ <https://pubmed.ncbi.nlm.nih.gov/17366811/>

Background for our conclusion and a critical evaluation of the SCHEER assessment and conclusion

The SCHEER conclusion is in stark contrast to several recent reviews of the scientific results on the carcinogenic effects. For instance, a former commissioner of ICNIRP concluded in November 2022 that *“there are consistent indications from epidemiological studies and animal investigations that RF exposure is probably carcinogenic to humans. The principle of ALARA—as low as reasonably achievable—ought to be adopted as a strategy for RF health and safety protection.”*⁸⁵

In 2019 a review by Miller et al. concluded: *“When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR should be categorized as carcinogenic to humans (IARC Group 1).”*⁸⁶

Peleg et al. (2022) reported increased number of cancer cases among young men occupationally exposed in military settings and concluded: *“The findings from our study add to the growing body of evidence underscoring the gross inadequacy of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) thermal standards. Based on our findings and on the previous accumulated research, we endorse the recommendations to reclassify RFR exposure as a human carcinogen, International Agency for Research on Cancer (IARC) group 1.”*⁸⁷

SCHEER downplays the finding of the majority of the meta-analyses. The conclusion is based on “weighing” the results of the meta-analyses, without distinguishing between results on long-term and most exposed users and short-term light exposure. It is self-evident that long term and most exposed groups are the most relevant groups to consider in cancer risk assessments. In particular, as long-term exposure (>10 yr) is not a rare occurrence in the population, on the contrary.

In this section, SCHEER quotes a range of meta-analyses regarding the association between mobile phone exposure and brain tumors, all showing an increased risk of brain tumors related to long term use (> 10 years):

These meta-analysis studies of long-term exposure show significant effects, while short time exposure in the same study (not cited) did not show effect:

- The meta-analysis by Prasad (2017) shows that *“for mobile phone use of 10 years or longer (or 30 >1640 h), the authors concluded that the overall result of the meta-analysis showed a significant 1.33-times increased risk.”* (Page 23).
- The meta-analysis by Wang and Gou (2016) showed that *“significant association was found between mobile phone use of more than 5 years and glioma risk (OR = 1.35, 95% CI: 1.09–1.62).”*
- Yang et al (2017) also found significant effects: *“There was a significant positive association between long-term mobile phone use (> 10 years) and glioma incidence (OR = 1.44, 95% CI 1.08-1.91), and a significant 10 positive association between long-term ipsilateral mobile phone use and the risk of glioma 11 (OR = 1.46, 95% CI 1.12-1.92).”*
- Bortkiewicz et al. (2017), found that a *“significantly higher risk of an intracranial 19 tumour (all types) was noted for the period of mobile phone use over 10 years (odds ratio 20 (OR) =*

⁸⁵ <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1042478/full>

⁸⁶ <https://pubmed.ncbi.nlm.nih.gov/30196934/>

⁸⁷ <https://www.sciencedirect.com/science/article/abs/pii/S0013935122019375?via%3Dihub>

1.324, 95% CI: 1.028–1.704), and for the ipsilateral location (OR = 1.249, 95% CI: 1.022–1.526).“

- Wang et al. (2018) found “A significant association with risk of glioma ...in long-term users (≥ 10 years) with odds ratio of 1.33 (95% CI, 1.05-1.67).⁸⁸
- Choi et al. (2020) reported that: “cellular phone use with cumulative call time more than 1000 h statistically significantly increased the risk of tumors. This comprehensive meta-analysis of case-control studies found evidence that linked cellular phone use to increased tumor risk”⁸⁹

The meta-analysis by Choi et al. (2020) reported that “all studies reporting cumulative call times greater than 1000 h, cellular phone use with cumulative call time greater than 1000 h (about 17 min per day over a 10-year period) increased the risk of tumors by 60%.”

Further, Choi et al. found that “meta-analyses by funding source revealed a non-significant increased risk of tumors by cellular phone use in studies not funded by the cellular phone industry (OR, 1.07; 95% CI, 0.98 to 1.17; $n = 28$; $I^2 = 21.9\%$), whereas a statistically significantly decreased risk of tumors was observed in studies partly funded by the cellular phone industry (OR, 0.81; 95% CI, 0.74 to 0.89; $n = 8$; $I^2 = 0\%$), all of which were INTERPHONE studies”. The conclusion was that studies so far show: “significant evidence linking cellular phone use to increased tumor risk, especially among cell phone users with cumulative cell phone use of 1000 or more hours in their lifetime (which corresponds to about 17 min per day over 10 years), and especially among studies that employed high quality methods.”

Here again SCHEER displays a striking bias as they ignore the indication that source of funding might have influenced the study which confirms previous results showing such influence.⁹⁰ Instead SCHEER claims that the Choi article “triggered significant criticism”, referring to two letters to the editor of the journal that published the Choi article, by other authors (Brzozek et al. 2021 and de Vocht and Rösli 2021). Interestingly, Ken Karipidis and Martin Rösli, coauthors of the letters, are members of ICNIRP and the ICNIRP cartel. Martin Rösli also receives funding from the mobile phone industry funded Swiss Research Foundation. To be objective, the SCHEER report should have also referred to the reply to the two letters by Choi et al., which points to the significant conflict of interest that SCHEER does not mention:

“The Brzozek et al. letter is the second letter to the editor regarding our current study. Ken Karipidis and Martin Rösli, the senior authors of these two letters, are two of the 14 commissioners on the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Their interest in our paper is not likely coincidental, because the major finding from both of our review studies was that heavier, long-term cell phone use was associated with significantly increased tumor risk. Because this finding calls into question the adequacy of ICNIRP’s radio frequency exposure guidelines to protect human health, ICNIRP may have a vested interest in manufacturing doubt about our research.”⁹¹

In order to be objective SCHEER should refer to all cases where the cited articles “triggers significant criticism” by other scientists, for instance Hardell (2021) criticism of the Health Council of the

⁸⁸ <https://pubmed.ncbi.nlm.nih.gov/29709736/>

⁸⁹ <https://pubmed.ncbi.nlm.nih.gov/33147845/>

⁹⁰ <https://pubmed.ncbi.nlm.nih.gov/17366811/>

⁹¹ <https://pubmed.ncbi.nlm.nih.gov/34073653/>

Netherlands report⁹² or the criticism of the ICNIRP 2020 report⁹³. But SCHEER is not objective and chooses only to refer to such criticism that undermines the results on increased risk for serious health risks and, once again, produces doubt to the benefit of the industry.

It should be noted that the so called “highest exposure” refers to the long-term exposure, and this exposure (e.g., 1000 hours accumulated exposure) is not extreme by any means, rather it is a common exposure scenario for large part of the population.

As mentioned, the applied method for weighing the evidence is highly unscientific. In the biological sciences, one negative finding does not “weigh up” the positive findings. Scientifically, the studies must be scrutinized to find out which factors may be causing the difference. Here it is quite evident that the major factor of interest in brain tumour research is duration and amount of exposure.

SCHEER's Violation on their Own Evaluation Criteria

As mentioned, SCHEER violated their own evaluation criteria (regarding relevant exposure) in their reference to the Wang. This violation does not stand alone. On page 16, SCHEER states, “The assessment of the exposure should be based on objective measurements, not on the personal recalls or provider’s information originating mainly from the bills paid (unsuccessful calls are not paid but the EMF emission is there while the customer waits)”. However, in section 4.2.2 SCHEER uncritically refers to two longitudinal studies as documentation for “*no cancerous effect*”. It is not mentioned which studies are referenced. Most likely, that they refer to the Danish cohort study (Johanssen and associates), where the “no effect finding” was a probable consequence of lack of relevant exposure of the so-called exposed group, while the control group was exposed. Accordingly, IARC in 2011 deemed the Danish cohort study to be uninformative due to “severe selection bias”. When referring to this study, SCHEER does not follow their own criteria for evaluation of the science, as the “exposure” was not based on objective measurements, instead it was simply assumed that the objects were using their phone to a relevant degree if they had a subscription. On top of these, the control group was contaminated with the group of phone user with the most intensive use (corporate phones, used professionally).

SCHEER continues (p 25), in the section on neoplasia, by referencing the recent cohort study update by Schüz et al (2022) ignoring severe bias. Firstly, the study does not use objective data (as called for by SCHEER, p. 16 in the SCHEER opinion), only recall data were used. Furthermore, the classification of the subjects in the “high risk group” was based on use of the phone on a daily basis - with no requirement on duration. In fact, 59% of the women in the “high exposure” group only used the phone less than 30 minutes per week. This is not a relevant high-risk exposure. SCHEER chooses to merit this single study, despite the severe flaws of the study^{94,95}, which should render it to be deemed “uninformative”. Not only does SCHEER not mention the severe criticism from Moskowitz (2022), Birnbaum et al. (2022) or Hardell et al. (2021)⁹⁶. It is remarkable that SCHEER finds it “necessary” (i.e., the selection criterion mentioned in the methodology) to include this study, even

⁹² <https://pubmed.ncbi.nlm.nih.gov/34189065/>

⁹³ <https://www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html>

⁹⁴ <https://academic.oup.com/jnci/advance-article/doi/10.1093/jnci/djac109/6608754?searchresult=1>

⁹⁵ <https://academic.oup.com/jnci/advance-article/doi/10.1093/jnci/djac110/6608698?searchresult=1>

⁹⁶ <https://www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html>

though it is not a meta-analysis or a systematic review, thus demonstrating the bias towards studies showing "no effect".

Even though SCHEER points to the importance of using objective data on exposure, they fail to report objective data from the CEFALO study on children. The study is referred in the section on ICNIRP concluding that *"The only study available on mobile phone use in children and brain tumor risk showed no increased risk of brain tumors,"* but this interpretation is false. On the contrary, the study indicated increased risk for brain tumors among children that had used mobile phones, using objective data. In a comment to the study, the Hardell group wrote:

"Further support of a true association was found in the results based on operator-recorded use [of mobile phones] for 62 cases and 101 controls, which for time since first subscription > 2.8 years yielded [odds ratio] OR 2.15 (95% [confidence interval] CI 1.07-4.29) with a statistically significant trend (P = 0.001) [.....] We consider that the data contain several indications of increased risk, despite low exposure, short latency period, and limitations in the study design, analyses and interpretation"[...] In fact, all ORs on mobile phone use were >1.0 according to Table 2 in the article [93]. For both ipsilateral and contralateral mobile phone use statistically significant increased risks were obtained for highest group of cumulative numbers of calls; OR = 2.91, 95% CI = 1.09-7.76 and OR = 4.82, 95 % CI = 1.21-19.24, respectively."⁹⁷

This significant finding in the CEFALO study was also highlighted in the recent scientific review by Miller et al. (2019)⁹⁸, but SCHEER has failed to include these reviews. This is another example of the biased selection of studies, omitting results and studies finding significant effects.

3.9 Neoplasia - Experimental in Vivo Studies on Animals – (SCHEER section 5.3.1.2)

SCHEER Conclusion

"Regarding carcinogenicity in animals, there is an overall uncertain weight of evidence due to the inconsistencies and partial inaccuracies in the rat studies, the different tumor responses in the (NTP) mouse studies compared to the rat studies (lack of species consistency in terms of observed effects), which increases uncertainty about the relevance of these effects to humans."

Our Conclusion

During the last years, two very large and well performed animal studies from two different highly esteemed laboratories (NTP and Ramazzini Institute) have both reported similar cancer effects in rats. The SCHEER conclusion is again a clear example of the severe bias within SCHEER and the tendency to manufacture doubt on evidence for harmful effects.

Background for our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion

According to former ICNIRP member James Lin *"it is noteworthy that the NTP/NIEHS and Ramazzini RF exposure research showed comparable findings of cardiac schwannomas and cerebral gliomas.*

⁹⁷ <https://www.fortunejournals.com/articles/aspects-on-the-international-commission-on-nonionizing-radiation-protection-icnirp-2020-guidelines-on-radiofrequency-radiation.html>

⁹⁸ <https://pubmed.ncbi.nlm.nih.gov/30196934/>

*Thus, two comparatively well-conducted animal investigations using the same strain of rats demonstrated consistent outcomes in significantly elevated cancer risks.*⁹⁹

The study from the National Toxicology Program (NTP), a world leading toxicology institute, is described in brief. It is the largest mobile-phone radiation animal study so far, with highly controlled exact dosimetry, with radiation modulated as in telecommunication devices. It showed clear evidence of cancer effects in terms of *“exposure to GSM or CDMA modulations of RFR in male rats resulted in a statistically significant, positive trend in the incidence of schwannomas” (in the heart) and “In the brain, there was a significant, positive trend in the incidences of malignant gliomas in males exposed to CDMA-modulated RFR”.*¹⁰⁰

However, SCHEER claims that *“there is considerable uncertainty on how to interpret the study”* referring to a report from an expert group (SSM) within the closed circle of the ICNIRP cartel - thus referencing to themselves since the SSM report was co-authored by two of the authors of the SCHEER opinion (see chapter on conflicts of interests).

This is again an example of SCHEER’s consistent method, throughout their Opinion report, of casting doubt on research showing clear evidence of harmful effects below ICNIRP guidelines. More independent scientists have, during the last years, reviewed the NTP study and found that the results strengthen the evidence from human studies. For instance, Hardell and Carlberg concluded in 2018 that there is *“clear evidence that RF radiation is a multi-site carcinogen. Based on the Preamble to the IARC Monographs, RF radiation should be classified as carcinogenic to humans, Group 1”*¹⁰¹ Miller et al (2018) also came to the same conclusion.¹⁰²

The main argument brought forward by SCHEER is a claim that the correlation between exposure and schwannoma may be due to thermal effects (thermoregulatory stress). However, there is no evidence for this claim (that a small temperature increase, due to exposure close to the thermal exposure limits, would cause cancer). SCHEERs hypothesis is undermined by the facts that there was also an increase in the occurrence of schwannoma in the groups exposed 1.5 W/kg, which is below the thermal exposure limits set by ICNIRP, as opposed to no occurrence of cancer at all in the sham (control) group. Noteworthy, SCHEER fails to mention these findings that undermine SCHEER’s statement. SCHEER also fails to mention that there was an increase in endocardial Schwann cell hyperplasia (a pre-neoplastic stage to schwannoma) in the female rats, which further corroborates the findings in the male rats.¹⁰³ Thus, there was also an increase in pre-neoplastic changes particularly in the low and medium exposure groups, indicating a dose-response relation. These findings suggest that a similar significant increase in Schwannoma could be expected in the low exposure groups (1.5 W/kg) had the experiment been prolonged after 2 yrs. of age (corresponding to the findings in the Ramazzini study). The SCHEER also fails to mention that NTP found significant increase in malignant schwannoma in male rats at 900 MHz at both GSM and CMDA modulations, and that an array of other significant health effects was found in the exposed groups.

The findings in the NTP study were supported by the Ramazzini study, finding similar associations between exposure and schwannoma (Falcioni et al. 2018). In this study, the exposure was well below

⁹⁹ <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1042478/full>

¹⁰⁰ <https://www.biorxiv.org/content/10.1101/055699v3.full.pdf>

¹⁰¹ <https://www.spandidos-publications.com/10.3892/ijo.2018.4606>

¹⁰² <https://www.sciencedirect.com/science/article/abs/pii/S0013935118303475?via%3Dihub>

¹⁰³ <https://ntp.niehs.nih.gov/whatwestudy/testpgm/cartox/criteria/index.html>

the thermal exposure limits, and similar to exposure of humans to radiation from base stations (50 V/m is below the ICNIRP guidelines for base station RF radiation for 1.8 GHz (58.2 V/m)).

The Ramazzini study showed that exposure to 1.8 GHz GSM base stations caused *“A statistically significant increase in the incidence of heart Schwannomas was observed in treated male rats at the highest dose (50 V/m). Furthermore, an increase in the incidence of heart Schwann cells hyperplasia was observed in treated male and female rats at the highest dose (50 V/m), although this was not statistically significant. An increase in the incidence of malignant glial tumors was observed in treated female rats at the highest dose (50 V/m), although not statistically significant”*¹⁰⁴

These findings further show that the carcinogenic effects found in the NTP study were not due to thermal effects.

SCHEER claims that the finding of the Ramazzini study was not in consistency with the findings in NTP, referring again to the report from SSM co-authored by themselves and within the closed circle of the ICNIRP cartel (see Chapter 2 on conflicts of interest):

“By contrast to the authors’ conclusion, the results are not consistent with those of the NTP study, where no increased tumour incidences were found with the exposure level of 1.5 10 W/kg (SSM, 2019)”.

This is a false statement for the reasons mentioned above: The animals in the lowest exposure group (1.5 W/kg) in the NTP study did have Schwannoma in contrast to the control rats, although the difference was not significant. They also had an increased occurrence of pre-cancerous changes in the Schwann cells that would likely have evolved to Schwannoma (and significantly increased occurrence of Schwannoma), had the rats lived longer than two years. In the Ramazzini study, the rats lived until natural death, and therefore the Schwannoma had more time to evolve. A fact that SCHEER may have missed because they did not reference the study itself, instead they referenced an interpretation by the Swedish radiation authorities. The fact is that the findings in the Ramazzini study and the NTP study are consistent.

A study by Lerchl et al. (2015)¹⁰⁵ found a significant co-carcinogenic effect of radiation below the thermal exposure limits. This is clear evidence for the existence of a mechanism causing pathological effects from long term exposure below the thermal exposure limits. Nevertheless, SCHEER aim to undermine the findings by criticizing that the study did not monitor temperature. This is an irrelevant critique, because the exposure was below the thermal exposure limits, and there is no evidence that minor fluctuations in room temperature can cause the observed effects. The study is claimed to be inconsistent because there is not a clear dose-response correlation – this is also an irrelevant critique because the study does not aim at determining a dose-response relation, and there is no doubt that the difference between the exposed group and the control group lies in the exposure.

When IARC classified RF EMR as a class 2b in 2011, the main reason that it was not classified as a class 2a or a class 1 carcinogen was due to the lack of sufficient animal studies. This fact is also ignored by SCHEER. It is important, because it follows that the findings in the high-quality animal studies (NTP study and the Ramazzini study) are highly important for the evaluation of cancer risk in humans. The cancer risk in humans is supported by the finding of the same type of tumors in animals. The schwannoma is closely related to the malignant gliomas (i.e., cells of the same

¹⁰⁴ <https://www.sciencedirect.com/science/article/abs/pii/S0013935118300367>

¹⁰⁵ <https://pubmed.ncbi.nlm.nih.gov/25749340/>

embryonic origin, both supporting the nervous system). The difference in location is a likely result of the full body exposure of the animals in contrast with the main exposure on the head in humans. Thus, the animal studies support the association between glioma and mobile phone radiation in humans.

3.10 Cardiovascular Diseases (SCHEER section 5.3.4)

SCHEER Conclusion

“There is strong evidence for the lack of effects on the cardiovascular system in the above frequency range (700-2200 MHz), but weighing of evidence is not possible for other frequencies of RF EMF.”

Further, SCHEER argues that *“A meta-analysis that investigated the effects of using a GSM900 mobile phone on heart rate variability (HRV) has concluded that the minutes of exposure (minutes of speaking on the mobile phone) do not affect the autonomic nervous system of the heart or its sympathovagal balance (Geronikolou et al., 2018). This result is in agreement with the conclusion of the review conducted by the Health Council of the Netherlands that no effects of exposure to radiofrequency electromagnetic fields on the cardiovascular system and the autonomic nervous system have been found in the frequency range of 700-2200 MHz.”*

Our Conclusion

SCHEER’s conclusion is severely misleading and is based only on short-term laboratory human studies, excluding all animal studies, and not taking into consideration that in real life, humans are chronically exposed 24h/day to multiple signals and many frequencies. Numerous animal studies show harmful effects on the heart. The SCHEER’s opinion is unscientific and misleading, stating that there is *“strong evidence for a lack of effects”* on the cardiovascular system in the frequency range 700-2200 MHz. SCHEER ignores all animal studies showing harmful effects on the heart and cardiovascular system without any explanation. In fact, effects on the heart is one of the most prevalently reported effects from real life exposure and was reported in the scientific literature already five decades ago.¹⁰⁶ Other scientists recently concluded that human and animal studies *“show that the cardiovascular system is sensitive”* to RF radiation.¹⁰⁷ SCHEER further fails to acknowledge the relevance for cardiovascular health of the evidenced in-vitro findings, e.g. the effects on calcium flux and the oxidative stress effects. SCHEER mentions the evidence for these effects in other chapters but fails to acknowledge that these findings are evidence for possible mechanisms that may cause the evidenced effects on the heart.

Background for our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion

Firstly, it should be noted that the SCHEER conclusion of “strong evidence for no effect” is unscientific in itself (see section 3.4, subsection regarding evaluation of the “Weight of Evidence”). Furthermore, the conclusion is in contradiction to the methodology that SCHEER claims to adhere to:

¹⁰⁶ https://www.stralskyddsstiftelsen.se/wp-content/uploads/2020/12/1971book_marha.pdf

¹⁰⁷ <https://www.ewg.org/research/radiofrequency-electromagnetic-fields-may-affect-heart-health-new-ewg-analysis-finds>

“Strong weight of evidence: Coherent evidence from a primary line of evidence (human, animal, environment) and one or more other lines of evidence (in particular mode/mechanistic studies) in the absence of conflicting evidence from one of the other lines of evidence (no important data gaps)”

There is indeed evidence showing adverse cardiovascular effects from both long term and short-term exposure, which invalidates the conclusion of “strong evidence for a lack of effects” – thus, the available scientific evidence is conflicting with the SCHEER conclusion. There are many animal studies showing harmful effects from RF exposure:

In November 2022, a group of scientists within the Environmental Working Group (EWG)¹⁰⁸, published a review of the available evidence of RF effects on the heart. Contrary to SCHEER, the EWG scientists present evidence from both animal and human studies showing harmful effects on the heart and it is concluded:

“Electromagnetic radiation in the radiofrequency range emitted by cell phones, tablets and other wireless communication devices is absorbed by the human body and may affect heart health [...] Human and animal research studies show that the cardiovascular system is sensitive to radiofrequency radiation. The developing organism, from the fetal stage through early life, is especially vulnerable to these exposures and their potential harms”¹⁰⁹

The EWG lists a number of animal studies published in scientific papers showing harmful effects on the heart (table 1).

Also in November 2022, the study *“The effects of long-term prenatal exposure to 900, 1800, and 2100 MHz electromagnetic field radiation on myocardial tissue of rats”* reported that prenatal exposure to these frequencies for a period of 24 hours per day for 30 days caused damage to the heart of the newborn animals.¹¹⁰

Observational studies have shown that cardiovascular symptoms are the most common effects recorded as an effect of RF radiation from the mobile base stations (Eger & Jahn, 2010¹¹¹; Shinjyo and Shinjyo, 2014¹¹²). A study by Singh et al, (2016)¹¹³ showed that living in the exposure from mobile base stations was related to a higher risk of hypertension, in accordance with the results from animal studies.

SCHEER claims to preferably include meta-analyses and scientific reviews, but also ignores a recent systematic, scientific review (Jarreh and Rababa, 2022) showing that mobile phone exposure is associated with cardiovascular changes in human adults and fetal heart rate variability during pregnancy¹¹⁴.

Further, SCHEER has only considered an extremely selective part of the available science on cardiovascular effects: SCHEER is supposed to assess risks for all RF frequencies between 100 KHz and

¹⁰⁸ <https://www.ewg.org/research/radiofrequency-electromagnetic-fields-may-affect-heart-health-new-ewg-analysis-finds>

¹⁰⁹ <https://www.ewg.org/research/radiofrequency-electromagnetic-fields-may-affect-heart-health-new-ewg-analysis-finds>

¹¹⁰ <https://pubmed.ncbi.nlm.nih.gov/36383165/>

¹¹¹ www.emf-portal.org/en/article/18762

¹¹² <https://mdsafetech.org/wp-content/uploads/2021/10/shinjyo-t-and-shinjyo-a.-2014-significant-decrease-of-clinical-symptoms-after-mobile-phone-base-station-removal-e28093an-intervention-study.-.pdf>

¹¹³ <https://pubmed.ncbi.nlm.nih.gov/27011934/>

¹¹⁴ <https://pubmed.ncbi.nlm.nih.gov/35155842/>

300 GHz, but only refers to one meta-analysis on effects of 900 MHz on humans, and one review report from the Health Council of the Netherlands, including effects from exposure to 700 – 2200 MHz only on humans. However, WiFi, 4G and 5G use frequencies that are outside that frequency band. The SCHEER considered no studies on exposure to other frequencies.

The meta-analysis (Geronikoulou et al., 2020) referenced in the SCHEER report included only four studies (one was split into two datasets), solely investigating the effect of vagal suppression on the heart rate variability (HRV) from minutes of exposure of healthy humans in laboratory settings to mobile phone RF at 900 MHz. The paper concluded that a *“risk assessment analysis of the additive effects of continuous exposure (exposome) is strongly suggested”* but that latter conclusion is not mentioned by SCHEER. However, SCHEER deducts from this meta-analysis that it is *“evidence for lack of effect on the cardiovascular system”*. This is a severely misleading conclusion, as the meta-analysis only considered four studies on healthy subjects for effects on the HRV, with exposure times up to only 35 minutes. The meta-analysis should have been deemed non-informative due to the design, because other available evidence consistently indicates that effects on HRV in healthy subjects cannot be expected in experimental studies using such short exposures:

1) Electrohypersensitive (EHS) persons show changes in HRV at such short exposure times (Belpomme and Irigaray, 2022), but there is no evidence to support that people without EHS cannot be expected to show changes in HRV at long term exposure times.

2) Animal studies show significant changes in HRV only after extended periods (Misek et al 2019),

3) A cross-sectional study (Alam and Choudhary, 2018) found that smartphone use lasting for more than 1 h caused decreased HRV.

4) In 2016, a study (Ekici et al.) concluded that *“the duration of mobile phone use may affect the autonomic balance in healthy subjects. The electromagnetic field created by mobile phone use may induce HRV changes in the long term.”*

5) A recent large animal study (Dauda Usman et al. 2020) indicates that the radiation causes a significant increase in systolic, diastolic and mean arterial BP. The HRV vagal response showed a non-significant decrease, similar to the finding in the meta-analysis on human studies.

In the study referenced by SCHEER (Geronikoulou et al., 2020), 29 scientific studies on cardiovascular effects were identified, while only 4 studies were included in the meta-analysis. Thus, at least 25 more studies on effects on humans (in addition to animal studies) should be investigated in order to determine whether there is evidence for cardiovascular effects.

The second reference quoted by SCHEER, is the report from the Health Council of the Netherlands (HCN) (not peer-reviewed). It includes 25 studies on cardiovascular effects in humans, of which 24 are short term and only one is long term (1 epidemiological and 24 experimental) on exposure within the 700-2200 MHz range. The only long-term study showed unfavorable effects (according to HCN). Of the 25 studies, three are reported to have shown unfavorable effects and the others no effects. Twenty (20) other studies were excluded (Table 20 in the report) from the evaluation. Eleven of the excluded studies show adverse effects on the cardiovascular system. Two other studies investigated other frequencies (Wi-Fi and radar (20-40 GHz)), one of which was on long term exposure that showed adverse effects.

Consequently, only two included studies in the HCN evaluation are epidemiological studies on long term effects and both show adverse impact on the cardiovascular system, thus invalidating the conclusion by SCHEER based only on very short-term exposure.

Other Relevant Studies Omitted by SCHEER Regarding Mechanism and Effects on the Cardiovascular System

In 2017, Bandera and Weller reported that 216 out of 242 RF studies that examined effects related to oxidative stress (OS) found significant effects *and that “OS is known to be implicated in CVD (Cardiovascular Diseases) and therefore RF-EMR, a new ubiquitous environmental exposure, may contribute to CVD by maintaining chronic OS, and thereby causing oxidative damage to cellular constituents and altering signal transduction pathways.”* They further report that *“Dysregulation of the autonomic control of the cardiovascular system in healthy men (under 50 years) occupationally exposed to RF-EMR has been reported compared to their unexposed colleagues, as well as altered heart rate variability under acute experimental exposure to cordless and mobile phones.”* Also, Bandera and Weller note that *“the risk of hypertension, hypercholesterolaemia ...was significantly higher in the occupationally radiofrequency-exposed radio/TV station operators (mean age 47.9 years) compared to their occupationally unexposed colleagues in a study by researchers at the Bulgarian National Centre of Public Health Protection.”*

Evidence of acute direct effects on the heart

On page 9, SCHEER acknowledges that *“Several studies have included multiple cell lines and assessed functions such as intra- and intercellular signalling, membrane ion channel currents and input resistance, Ca²⁺ dynamics, signal transduction pathways, cytokine expression, biomarkers of neurodegeneration, heat shock proteins, and oxidative stress-related processes”*. Nevertheless, SCHEER claims that *“There is no evidence of effects of RF EMF on physiological processes that impair human health”*.

SCHEER overlooks the fact that interference with the transport of Ca²⁺ across the cell membrane signaling will inevitably affect the heart muscle cells and directly disturb the heart rhythm. The direct effect on the heart is more likely to be arrhythmia or tachycardia, as an increase in influx of Ca²⁺ will make the heart more excitable. In accordance, Rubik (2017) showed that exposure to smartphone EMF radiation for 35 min. at a distance less than one meter was associated with an increase in HRV. This mechanism explains the observed disturbance of the fetal heart rhythm in humans (e.g., Jarreh and Rababa, 2022)¹¹⁵.

In summary, the evidence suggests at least two mechanisms responsible for the effect of RF radiation on the heart rate: Short-term exposure of the heart will cause an increase in the heart rate (tachycardia or arrhythmia) due to the effect on Ca²⁺ flux. However, over time vagal suppression will gradually take over causing a suppression on the HRV.

As mentioned, SCHEER omits all animal studies on cardiac effects without explanation. Among these, the NTP study showed significantly increased incidence of both heart schwannoma and cardiomyopathy or damage to heart tissue in exposed animals when compared to control animals. One of the main established causes of cardiomyopathy in humans is long-term increase in blood

¹¹⁵ [www.cell.com/action/showPdf?pii=S2405-8440\(22\)00203-1](http://www.cell.com/action/showPdf?pii=S2405-8440(22)00203-1)

pressure, which was one of the significant effects from RF-EMR exposure in an animal study (Usman et al. 2022).

3.11 Neurophysiological and Neuropsychological Human Studies (SCHEER page 5.3.2)

3.11.1 Sleep (SCHEER section 5.3.2.2)

SCHEER Conclusion

“It was not possible to derive firm conclusions on RF EMF effects on sleep”, (Referring to the SCENIHR 2015 report),

and further, referring to the Health Council of the Netherlands: *“It was not possible to clearly classify any of the studies that observed a RF EMF exposure effect on sleep as either favourable or unfavourable.”*

Our Conclusion There is sufficient evidence of negative impact of RF radiation at levels that are well below the ICNIRP limits to conclude that sleep is disturbed at exposure levels well below the thermal-based limits. The positive opinion by SCHEER on adoption of ICNIRP 2020 guidelines is not based in science, as the evidence does not support that long term nighttime exposure at ICNIRP proposed maximum levels is safe for public health. In contrast, the evidence suggests that effects on sleep exist, potentially affecting large parts of the population, and thus that the limits should be lowered. SCHEER's conclusion is based on several methodological errors in the evaluation of the evidence.

Background for our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion

Sleep is very important for human health. It is well acknowledged that poor sleep during extended periods can lead to many chronic diseases. Sleep disturbances and insomnia are among the most commonly reported effects among people suffering from health effects from exposure to RF such as 3G, 4G, 5G and Wi-Fi. There is also abundant evidence supporting that RF negatively impacts sleep. Sleeping problems as a result of long-term RF-exposure was already described as an effect from RF exposure five decades ago in studies on exposed workers.¹¹⁶

Today most people in EU are chronically exposed to increasing levels of RF radiation during night-time. Night-time exposure is the most important factor to consider when evaluating RF effects on sleep. The major sources for RF exposure during night-time are base stations and mobile phone masts, Wi-Fi routers and so-called smart meters. Mobile phones may also be a significant contributor to nighttime exposure if the phone is a modern smart phone, placed near the bed and not turned off.

The most important studies for evaluating RF effects on sleep are those on base station real life exposure. All the available studies on base station health impact so far, have been performed on people exposed to RF levels from 1.000 to 20.000 times lower than the ICNIRP limits. The majority of these studies have found negative effects (microwave syndrome or illness/cancer) according to a meta-analysis published 2022 (Balmori 2022: Evidence for a health risk by RF on humans living

¹¹⁶ https://www.stralskyddsstiftelsen.se/wp-content/uploads/2020/12/1971book_marha.pdf

around mobile phone base stations: From radiofrequency sickness to cancer)¹¹⁷. One of the most prevalent symptoms from base station exposure is disturbed sleep/insomnia. There are at least 13 studies published between 2000 and 2021 (Balmori 2022)¹¹⁸ showing that people living near base stations or mobile phone masts have an increased risk of sleep disturbances from real-life long-term exposure. The first two studies on health effects from a 5G base station (case reports) reported that insomnia was one major rapidly emerging health effect although the measured exposure was far below the ICNIRP guidelines.^{119,120} There is no scientific evidence to support that 5G does not cause severe sleep disturbances at the exposure levels proposed by SCHEER and ICNIRP.

The authors of the SCHEER report spread doubt about the abundant evidence for the negative effect of RF on sleep in an unscientific way by referring to SCENIHR 2015, although as many as 49 of the studies referenced in that report showed effects on sleep. In short, SCHEER claims that because the 49 studies showing effects were not performed in the exact same manner, it should be concluded that there are no harmful effects on sleep at or below ICNIRP limits because of claimed inability “to derive firm conclusions”. Again, the radiofrequency radiation producing industry is given the benefit of the produced doubt, not the exposed public:

“SCENIHR (2015) concluded that half of 49 the studies looking at the macrostructure of sleep (especially those with a longer duration of exposure) observed effects. However, the results were not consistent with regard to the affected sleep parameters. Studies investigating effects of RF EMF exposure on the power spectra of the sleep EEG are quite heterogeneous with regard to several factors, e.g. the applied field, the duration of exposure, the timing of exposure (prior to or during sleep), the number of considered EEG leads, control of electromagnetic interference, the affected frequency band, the affected sleep stage, and time frames of investigation (e.g. whole 1 night, first 20 or 30 min of NREM sleep or NREM stage 2 sleep, first or later sleep cycles, 2 4th NREM episode). Furthermore, studies vary with regard to statistical analysis. Effect sizes and/or a priori sample size calculations are usually not reported. Given all these heterogeneities, SCENIHR (2015) concluded that it was not possible to derive firm conclusions on RF EMF effects on sleep.”

The fact that different study designs are used is not a valid scientific reason to reject the results from those studies showing negative impact on sleep from RF radiation. On the contrary, as Munafò and Davis wrote in Nature¹²¹ “Results that agree across different methodologies are less likely to be artefacts.” Thus, the fact that effects on sleep if found across different methodologies is strengthening the findings. SCHEER discards the evidence with false arguments.

Further, SCHEER refers to the Health Council of the Netherlands report 2020, where ICNIRP’s chairman is secretary:

“The Health Council of the Netherlands identified 18 human sleep studies (all refer to the 700 – 2200 8 MHz frequency range). Three investigated effects of a mobile phone base station signal, two of them observed an effect. Of 15 studies, that investigated effects of mobile phone exposure (healthy

¹¹⁷ <https://pubmed.ncbi.nlm.nih.gov/35843283/>

¹¹⁸ <https://pubmed.ncbi.nlm.nih.gov/35843283/>

¹¹⁹ https://www.gavinpublishers.com/assets/articles_pdf/Case-Report-The-Microwave-Syndrome-after--Installation-of-5G-Emphasizes-the-Need-for--Protection-from-Radiofrequency-Radiation.pdf

¹²⁰ <https://www.anncaserep.com/open-access/development-of-the-microwave-syndrome-in-two-men-shortly-after-9589.pdf>

¹²¹ www.nature.com/articles/d41586-018-01023-3

adults: 13, patients: two), nine found an effect, including one study in 11 patients. This review does not differentiate between effects on the macro- and the microstructure of sleep. It was not possible to clearly classify any of the studies that observed a RF EMF exposure effect on sleep as either favourable or unfavourable.”

A major problem with this kind of evaluation is that SCHEER has not done a quality investigation of the individual studies in the Health Council’s list of studies on sleep (table 41), and it is not evaluated whether the Health Council did a correct reporting of the results. Further, they did not investigate whether systematic differences in study design (e.g., differences in exposure, selection of study subjects, or observation parameters) could account for the different outcome. This is in striking contrast to the mission of “excellence” in the work.

There are several examples of errors in their list of studies on sleep from the Health Council of the Netherlands, which SCHEER failed to comment on. Below four examples are given:

1. a) *“Söderqvist and associates (2008) reported to have shown no association with sleep disturbances from mobile phone use”* (Table 41). However, this study reports that *“Some of the most frequently reported health complaints were tiredness, stress, headache, anxiety, concentration difficulties and sleep disturbances”*. Thus, this study suggests that mobile phone use was related to sleep disturbances.¹²²
2. The Cosmos cohort study (Tettamanti et al., 2020) was the largest study on sleep impact from mobile phone use this far, including over 24.000 participants. This study is referenced by the Health Council of the Netherlands for studying base station exposure and finding no association with sleep disturbance (table 41). Both claims are wrong. This is a study on mobile phone users and the study did find that mobile phone use increased the risk of insomnia: *“For insomnia, an odds ratio (OR) of 1.24, 95% CI 1.03-1.51 was observed in the highest decile of mobile phone call-time (>258 min/week).”*¹²³ The study also showed an increased OR of 43% for highest group of users (258 min./week or more) of insomnia and also “less adequate sleep” before adjustment for a range of factors such as education, smoking, body mass index for instance. The authors of this study, funded by major telecom companies such as Ericsson and Telia, adjust this result *“for the lower RF exposure from the UMTS than the GSM network”*. This adjustment with a factor of 150, efficiently washed away the result on insomnia, but the adjustment has no scientific basis. There are no studies indicating that UMTS mobile phone use is to such a degree less likely to impact sleep than GSM. On the contrary, other studies indicate that UMTS may be more biologically active despite a lower intensity, due to the different band width and/or different modulation.¹²⁴
3. The Rösli et al. 2010 study is claimed to show favorable association/lower risk of base station RF exposure on sleep disturbances. The study’s contradictory results do not support the claim made by the Health Council. Furthermore, there is no evidence, from laboratory studies, animal studies or epidemiology that would support a beneficial effect from mobile phone base station RF exposure on sleep. The study is of low quality and exposure from base station was “modelled” which leads to high probability of systematic errors compared to real

¹²² <https://pubmed.ncbi.nlm.nih.gov/18495003/>

¹²³ <https://pubmed.ncbi.nlm.nih.gov/32276731/>

¹²⁴ <https://pubmed.ncbi.nlm.nih.gov/18839414/>

exposure situations. Furthermore, the study results indicate that EHS individuals would use mobile phones, cordless phones and WLAN more or only slightly less than non-sensitive individuals, which is unlikely for real EHS individuals. This further indicates systematic errors within the study.

No experimental (controlled) study has investigated impact on sleep from nighttime exposure during prolonged periods close to, or at the ICNIRP limits, or even at 100 times lower levels (10 000 000 to 100 000 microwatts per square meter averaged over 6 minutes), using modulated radiation. Thus, the available experimental studies on humans do not represent common relevant risk exposure.

However, there are controlled studies on animals supporting the observed negative impact on sleep in humans in observational studies. In 2021, it was shown that prolonged exposure of mice to 2.4 GHz EMR, modulated by 100-Hz square pulses at a non-thermal output level results in markedly increased time of wakefulness in mice” (Liu et al. 2021)¹²⁵. In accordance with this study, a previous study on rats found that modulated 900 MHz RF radiation affected sleep (Mohammed et al. 2013)¹²⁶. Clearly, modulation and pulsation are important factors to take into consideration.

Although a majority of the studies referred to by SCHEER themselves showed effects on sleep from base stations or mobile phones (11 of a total of 18 studies), SCHEER concludes that *“the weight of evidence is uncertain.”*

Again, this SCHEER conclusion is not scientific, because the methodology for assessing (“weighing”) the evidence is unscientific (see section 3.4). Their assessment does not take into consideration the relevant differences in study design and does not investigate the potential explanation for the different outcomes. Further, as shown above, important studies are omitted and several of the referenced studies are misinterpreted.

3.11.2 “Symptoms” (SCHEER section 5.3.3)

SCHEER Conclusion

“SCENIHR (2015) concluded that the results from multiple double-blind provocation studies gave a strong overall weight of evidence that such effects are not caused by RF exposure, and that the evidence from observational studies weighed against a causal effect between EMF exposure and non-specific symptoms (IEI-EMF). The SCHEER finds that the conclusion is still valid. “

Our Conclusion

SCHEER’s conclusion that there is strong evidence that RF does not cause symptoms, described in the scientific literature as microwave syndrome, radiofrequency illness and EHS, is grossly misleading. The referenced double-blind provocation studies suffer from severe flaws and biased design and should be discarded. On the contrary, there is increasing evidence that RF causes the physiologic responses behind these symptoms. It illustrates once again the bias of SCHEER and its tendency to draw conclusions that support a continued adoption of ICNIRP limits, which ultimately benefits the telecom industry. The physiologic responses arise well below ICNIRP limits and there is no evidence

¹²⁵ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8346830/>

¹²⁶ <https://pubmed.ncbi.nlm.nih.gov/25685416>

to support that chronic RF exposure to a 5G or 4G base station at ICNIRP levels does not cause symptoms of the microwave syndrome in humans.

Background for our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion

Symptoms such as sleep disturbances, headache, dizziness, nausea, tinnitus, heart palpitations, depression have been described already five decades ago as an effect on workers exposed to chronic exposure to RF (microwave) radiation.¹²⁷

*Carpenter (2015) pointed out that "Soviet bloc countries reported that individuals exposed to microwaves frequently developed headaches, fatigue, loss of appetite, sleepiness, difficulty in concentration, poor memory, emotional instability, and labile cardiovascular function, and established stringent exposure standards."*¹²⁸

These symptoms were called the microwave illness, microwave syndrome or radiofrequency sickness. Today the symptoms are often called "electro-hypersensitivity" (EHS). In the latter case, symptoms appear already at very low exposure.¹²⁹ According to the review by Carpenter (2015): "There is increasing evidence that the "microwave syndrome" or "electro-hypersensitivity" (EHS) is a real disease that is caused by exposure to EMFs, especially those in the microwave range."

Further, according to the ICBE-EMF commission 2022:

*"EHS has been proven to be a physical response under blinded conditions and, in addition to these studies, acute EMF-induced changes in cognition, behavior, and physiology reactions have been observed in studies involving animals, which cannot be biased by media-cultivated fears. These studies provide further evidence which invalidates the nocebo response (physical symptoms induced by fear) as causal regarding symptoms"*¹³⁰

These two conclusions invalidate SCHEER's claim that there would be "strong evidence" that these effects are not caused by RF.

Studies on people using mobile phones and people living near mobile phone masts and base stations have confirmed the early studies reporting symptoms from RF radiation long term exposure 50 years ago. RF emitted from mobile phones and base stations increases the risk of these symptoms.

According to a meta-analysis covering studies on base stations and mobile phone masts published between 2002 and 2021 (Balmori 2022)¹³¹ a clear majority of studies on symptoms around base stations (17 of 23 studies) showed increased risk of these symptoms (radiofrequency sickness). Among the most commonly found symptoms are sleep disturbances, headache and dizziness. The first studies on human exposure to RF from a 5G base station reported that 5G rapidly caused the

¹²⁷ https://www.stralskyddsstiftelsen.se/wp-content/uploads/2020/12/1971book_marha.pdf

¹²⁸ Carpenter 2015 <https://pubmed.ncbi.nlm.nih.gov/26556835/>

¹²⁹ <https://pubmed.ncbi.nlm.nih.gov/32289567/>

¹³⁰ https://icbe-emf.org/wp-content/uploads/2022/10/ICBE-EMF-paper-12940_2022_900_OnlinePDF_Patched-1.pdf

¹³¹ <https://pubmed.ncbi.nlm.nih.gov/35843283/>

microwave syndrome symptoms, suggesting that 5G may be even more toxic than the preceding technologies.^{132,133}

Animal studies give support to the evidence from studies on humans; for instance, induction of stress and anxiety behavior, reduced memory and learning, and sleep disturbances.¹³⁴

However, SCHEER ignores that the evidence is accumulating showing that RF radiation causes these symptoms. Concurrently, there are no well conducted studies that do not find these symptoms in humans exposed to 3G, 4G or 5G from telecommunications base stations, stemming from chronic full-body exposure to RF radiation at ICNIRP limits or even at 100 times below. Thus, there is no evidence whatsoever to support the ICNIRP chairman's claim that there would be no effects on health from chronic exposure from a nearby 5G base station, if the ICNIRP's limits 2020 are adhered to.¹³⁵

Provocation Studies

The fact that most of the provocation studies are flawed and deemed to fail by design has been documented in several reviews (Leszczynski, 2021; Belpomme et al. 2021¹³⁶; Belpomme and Irigaray 2022¹³⁷), of which only Leszczynski is mentioned by SCHEER.

The review by Belpomme et al. (2022) supports that the vast majority of the provocation studies are deemed to fail due to their design. Some of the typical errors are listed in Table 3 in the review (*Lack of precise inclusion criteria, No objective criteria based on molecular biomarkers and imaging techniques, No clear consideration on medical anamnesis and degree of EHS severity; No consideration of an association with MCS; No consideration that EHS patients are intolerant to specific man-made EMF frequencies; Too short exposure duration; Symptom recording made too early; Endpoint criteria depending on subjective statements; Possible EHS-associated psychological conditioning due to past suffering; Possible significant EMF levels during sham exposure*)

SCHEER references only Leszczynski (2021) but fails to mention Leszczynski's conclusions: *"It is time to drop out psychology driven provocation studies that ask about feelings-based non-specific symptoms experienced by volunteers under EMF exposure. Such research approach produces only subjective and therefore highly unreliable data that is insufficient to prove, or to disprove, causality link between EHS and EMF."* SCHEER is unable to refute this conclusion, but merely ignores the fact in their final opinion.

SCHEER also concludes that *"SCHEER is of the opinion that future research should always include objective measures (physical/biochemical/biological markers) of the response to EMF exposure together with other types of psychological measures or subjective reports."* However, such studies are already published:

¹³² https://www.gavinpublishers.com/assets/articles_pdf/Case-Report-The-Microwave-Syndrome-after--Installation-of-5G-Emphasizes-the-Need-for--Protection-from-Radiofrequency-Radiation.pdf

¹³³ <https://www.anncaserep.com/open-access/development-of-the-microwave-syndrome-in-two-men-shortly-after-9589.pdf>

¹³⁴ See both study results and references in this study:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8346830/#r11>

¹³⁵ <https://www.inverse.com/input/tech/scientists-rule-5g-is-safe-surprising-no-one-except-the-tinfoil-hat-brigade>

¹³⁶ <https://pubmed.ncbi.nlm.nih.gov/34298941/>

¹³⁷ <https://pubmed.ncbi.nlm.nih.gov/35537497/>

Provocation studies based on objective criteria have evidenced an association between EHS and (RF or LF) EMR exposure in provocation studies (Belpomme and Irigaray, 2022):

The applied objective criteria comprise: Pupillary light reflex; Attention, perception and memory tests; Reduced performance of visual attention and perception; Sleep disturbance; Double-blind cross-over provocation study; Sleep EEG; symptomatic responses; HRV and RBC clumping; HRV, capillary blood flow and SEP; HRV ELF; ECG and EMG.¹³⁸

These studies¹³⁸ using objective criteria are not referenced by SCHEER.

Evidence for the Pathogenesis of EHS

SCHEER fails to distinguish between the two diagnoses IEI-EMF (Idiopathic Environmental Intolerance Attributed to EMF) and EHS (Electro-HyperSensitivity), which is important for the evaluation of the scientific studies, as the response may differ significantly depending on which syndrome the subjects is suffering from.

It should be noted that the term EHS is misleading, as the syndrome is not hypersensitivity in the same way as allergies. EHS is a response to abnormal environmental exposures. Nevertheless, EHS is the terminology most often used to represent the reaction in the most sensitive individuals.

Regarding pathophysiology behind the objective parameters, Belpomme and Irigaray (2022)¹³⁷ summarize “*many EHS patients are characterized by possible low grade inflammation, nitroso-oxidative stress, BBB disruption/opening and brain neurotransmitter changes (Belpomme et al. 2015, 2018; Irigaray et al., 2018a; Belpomme and Irigaray, 2020); all of which have been shown in laboratory animals by different independent studies to be caused by man-made EMF exposure (Salford et al. 1994, 2003; Cao et al., 2000; Eberhardt et al., 2008; Nittby et al., 2009; Yang et al., 2012; Aboul Ezz et al., 2013; Megha et al. 2015a, 2015b; Saili et al., 2015; Hu et al., 2021).*”

Regarding the pathogenesis, Belpomme and Irigaray (2022)¹³⁶ summarize how known effects from EMF can trigger EHS, adding: “*We have shown that in 80% of the cases of EHS patients, EHS is associated with the production of reactive oxygen species (ROS) and/or reactive nitrogen species (RNS) free radicals, suggesting that EMFs could be indirectly involved in EHS genesis (Irigaray et al., 2018a).*”

SCHEER's Biased Conclusion

SCHEER's conclusion: “the results from multiple double-blind provocation studies gave a strong overall weight of evidence that such effects are not caused by RF exposure”, is unscientific and highly misleading. They mainly reference studies based on subjective criteria – not objective criteria, even though they call for such studies.

SCHEER chooses to ignore the existing studies based on objective criteria. SCHEER's conclusion is grossly misleading, even according to the criteria set by SCHEER themselves, ignoring important evidence obtained since 2015, in particular:

1) SCHEER ignores that the majority of observational studies showing a causal effect between RF exposure from base stations and symptoms described since many years as an effect of RF/microwave exposure at levels below ICNIRP thermal limits. (Balmori, 2022)

¹³⁸ Listed in Table 4 in <https://pubmed.ncbi.nlm.nih.gov/35537497/>

2) SCHEER fails to reference important recent systematic reviews and misquotes one important recent review.

3) SCHEER ignores that the provocation studies referenced by SCHENIR (2015) are deemed to fail to show effect by design and should be discarded due to errors in the design, which are causing a predetermined (no-effect) result.

2) SCHEER calls for studies based on objective criteria but fails to acknowledge that there exist well-conducted blinded and double blinded provocation studies using objective response criteria (e.g., response from the autonomic nerve system) showing an association between RF-EMR exposure and EHS (8 studies listed in Table 4 in Belpommes and Irigaray, 2022¹³²). These studies are not referenced by SCHEER.

4) SCHEER ignores that objective clinical parameters for diagnosis of EHS have been identified. These include both parasympathetic responses, biochemical parameters and imaging (Belpommes et al., 2021)¹³⁹

The opinion of SCHEER in support of adoption of the ICNIRP limits is based on an unscientific assessment of the available science; in the case of EHS, it is based on severely flawed studies, whereas important well conducted studies (or recent reviews of such studies) are not referenced.

Regarding Placebo or Nocebo Effect

It should be noted that in the section on ICNIRP, SCHEER is stating that *“A small portion of the population attributes non-specific symptoms to RF EMF exposure (IEI-EMF). Double-blind experimental studies have provided evidence that “belief about exposure” (e.g., the so-called “nocebo” effect), and not exposure itself is the relevant symptom determinant”*.

SCHEER does give any references to support this statement (none are listed). However, it follows from the evidence referenced above that this statement is false, and it is also refuted in the recent reviews e.g., Leszczynski (2021). Studies claiming to provide evidence for a nocebo effect suffer from severe errors in study design and do not at all provide the claimed evidence.

In the words of Belpomme and Irigaray (2022)¹³²: *“There are many independent provocation studies proving that ELF/RF/MW EMF can biologically damage the organism and are noxious agents in healthy people; while due to the use of incorrect methodology in EHS suffering patients, there is a limited number of studies showing pathophysiological changes and symptoms induction. Therefore, negative provocation studies definitely cannot exclude a causal role of EMFs in EHS patients.”*

The ICBE-EMF concluded that “EHS has been proven to be a physical response under blinded conditions [145, 151, 158, 159] and, in addition to these studies, acute EMF-induced changes in cognition, behavior, and physiology reactions have been observed in studies involving animals which cannot be biased by media-cultivated fears. These studies provide further evidence which invalidates the nocebo response (physical symptoms induced by fear) as causal regarding symptoms.¹⁴⁰

¹³⁹ www.ncbi.nlm.nih.gov/pmc/articles/PMC8304862/

¹⁴⁰ https://icbe-emf.org/wp-content/uploads/2022/10/ICBE-EMF-paper-12940_2022_900_OnlinePDF_Patched-1.pdf

3.12 Neurological and Neurobehavioral Animal Studies (SCHEER section 5.3.2.2)

SCHEER Conclusion

“The Opinion of SCENIHR (2015) still holds true that the weight of evidence for neurobehavioural findings in animal studies is uncertain”

Our Conclusion

SCHEER’s conclusion on neurological and neurobehavioral animal studies is unscientific, misleading, and contradicted by a substantial amount of scientific results showing harmful neurological and neurobehavioral effects. It is based merely on two reports, leaving out the substantial available scientific studies on neurobiological effects. Further, evidence on electrophysiological effects is discarded, based on unscientific criteria. According to a research summary by Henry Lai (2022), 244 studies (on animals, humans, cells) published between 2007 and 2020 found significant neurological effects. This comprises 73% of all studies (355) published during that period.¹⁴¹

Background for Our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion SCHEER again ignores that by now, there is massive and convincing evidence from animal studies, indicating that RF radiation has negative neurological impacts on the brain and animal behavior. Instead of referencing scientific studies, SCHEER again chooses to refer to reports i.e., reviews that are not published peer reviewed. Although SCHEER refers to the Health Council of the Netherlands 2020, concluding that in summary effects “are possible”, SCHEER gives the telecommunications industry the benefit of the doubt in producing this biased conclusion that the evidence is “uncertain”.

Apart from the Health Council report 2020, where chair of ICNIRP 2020 and member of the industry organization IEEE, Eric van Rongen, is secretary (see closed circle of the ICNIRP cartel page...), SCHEER also refers to another report by Eric van Rongen, despite the author’s obvious conflict of interests. The report by the two members of ICNIRP, Sienkiewicz and van Rongen (2019), reviewed 62 studies on spatial memory and learning. However, 17 studies were excluded due to “improper description of exposure”.

Studies on 5G are still very sparse. One single animal study so far has studied neurological effects from RF exposure similar to 5G: In October 2022, a study by Bektas et al. (2022)¹⁴² reported that 5G frequency 3.5 GHz (GSM modulated) exposure at a level well below ICNIRP limits (1,6 W/m² compared to ICNIRP’s 10 W/m²) caused an increased number of degenerated neurons in the CA1 region of the hippocampus in the exposed animals. In addition, the study showed that the exposure caused increased oxidative stress in the brain, and that hormones with a protective effect on the brain, such as irisin and nesfatin, were negatively impacted.

Further in November 2022, another study showed that *“the depression-like behaviour was induced in mice after 4.9 GHz RF exposure. In addition, the number of neurons significantly reduced and the level of pyroptosis obviously increased in amygdala rather than hippocampus. These results suggested that*

¹⁴¹ <https://bioinitiative.org/wp-content/uploads/2022/06/RF-Neurological-Effects-Abstracts-2022.pdf>

¹⁴² <https://www.sciencedirect.com/science/article/abs/pii/S0891061822000989#!>

4.9 GHz RF exposure could induce depression-like behaviour, which might be associated with the neuronal pyroptosis in amygdala” according to the authors of the study.¹⁴³

SCHEER does not reference any scientific studies, but refers to the lack of meta-analyses, and merely references the two reports. In view of the massive evidence available on neurological effects from the RF radiation from existing technologies, SCHEER should in this case have rendered it “necessary” (cf. the SCHEER inclusion criteria) to include experimental studies – but they choose to ignore all scientific evidence in this area.

Furthermore, SCHEER discards all evidence on electrophysiological effects by claiming that the available evidence uses different study designs. This is an unscientific approach.

3.13 Reproductive and Developmental effects (SCHEER section 5.3.4.3)

SCHEER conclusion

“The meta-analyses and reviews available since the SCENIHR (2015) Opinion show that the weight of evidence for reproduction and developmental effects is uncertain, due to conflicting information.”

Our conclusion

The weight of evidence for reproductive and developmental effects is very strong. A scientific (systematic) review at request by the STOA panel within the European Parliament Research Service in 2021 concluded that *“There is sufficient evidence of adverse effects on fertility in man” and “sufficient evidence of reproductive/developmental adverse effects in humans”¹⁴⁴*

Sufficient evidence was defined as “a causal association between exposure to RF-EMF and the specific adverse effect has been established. That is, a positive association has been observed in the body of evidence on exposure to the agent and the specific adverse effect in studies in which chance, bias, and confounding factors were ruled out with reasonable confidence.

The SCHEER conclusion is extremely biased and is mainly based on the manufacture of doubt, largely unfounded, and is in stark contrast to the STOA conclusion and other scientific reviews on the topic.

Background for our Conclusion and a Critical Evaluation of the SCHEER Assessment and Conclusion

SCHEER include in their weighing of evidence a meta-analysis that included 18 papers (Kim et al. 2021) but the conclusion of the referred paper is omitted by SCHEER. Kim et al. concluded that *“Mobile phone use decreased the overall sperm quality by affecting the motility, viability, and concentration. It was further reduced in the group with high mobile phone usage. In particular, the decrease was remarkable in in-vivo studies with stronger clinical significance in subgroup analysis. Therefore, long-term cell phone use is a factor that must be considered as a cause of sperm quality reduction.”*

¹⁴³ <https://www.tandfonline.com/doi/full/10.1080/09603123.2022.2149708>

¹⁴⁴ [https://www.europarl.europa.eu/RegData/etudes/STUD/2021/690012/EPRS_STU\(2021\)690012_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2021/690012/EPRS_STU(2021)690012_EN.pdf)

Instead, SCHEER raises doubt over the paper arguing, even though the study as conducted in accordance with the PRISMA guidelines, that “many of the studies did not provide adequate information on dosimetry” and that “at least one study” (of 18) was excluded by SCENIHR 2015 (which comprised three of the authors of the SCHEER report), without explaining by which criteria the dosimetry was considered “inadequate”. It is unscientific to use the criterion “inadequate dosimetry” rigorously to discard studies, because the aim of the SCHEER report focuses on hazard identification (establishing a causal relationship), which does not require a quantitative dose-response determination. In hazard identification, it is important that the exposure is relevant and sufficient in the exposure group. There are other more relevant criteria to ensure this, whereas dosimetry in itself does not ensure relevant exposure, because it does not describe modulation and polarization. It is important the exposure mimics real-life exposures regarding the quality and duration of the exposure, e.g., a mobile phone in speak mode or an active WiFi router is a relevant exposure.

SCHEER uses the same invalid argument regarding “inadequate dosimetry” to cast doubt on the conclusion in other meta-analysis., merely because they have included some studies (Jaffar et al. 20219; Maluin et al, 2021; Sciorio *et al.*, 2022) applying what SCHEER calls “inadequate dosimetry”.

Jaffar et al. 2019 that did a systematic review on effects from Wi-Fi on male reproductive system. Again, SCHEER omits the conclusion: “In conclusion, exposure towards 2.45 GHz RF-EMR emitted by Wi-Fi transmitter is hazardous on the male reproductive system.”¹⁴⁵

SCHEER mentions the systematic review by Maluin et al. 2021 on effects on male reproductive hormones. The author’s conclusion was: “Existing animal and human data on the effect of RF-EMR emitted from wireless devices on male reproductive hormones are inconsistent and difficult to evaluate due to the heterogeneity of study design. However, most studies are consistent with the assertion that long-term exposure to RF-EMR from mobile phones and Wi-Fi devices can disrupt male reproductive hormones, particularly testosterone. Thus, avoiding long-term and excessive use of mobile phone is advisable to reduce the detrimental effect of RF-EMR.”¹⁴⁶ SCHEER quotes the conclusion but omits the last phrase: “Thus, avoiding long-term and excessive use of mobile phone is advisable to reduce the detrimental effect of RF-EMR.”.

The systematic review by Scorio et al. (2022) is on mobile phone radiation effects on sperm quality. SCHEER acknowledges that the review is taking the limitations of the studies into account: “it should be noted that Sciorio et al. (2022) comprehensively present the limitations of the studies on RF EMF exposure and the reproductive system, like controlling confounders, assessing exposure, and using standardised methods for sperm analysis.” The Scorio et al review concluded that “These findings suggest an adverse effect of cell phone radiation on sperm fertilization potential. Overall, the existing evidence from human studies seems to indicate that exposure to mobile phone radiation decreases sperm motility, particularly rapid progressive motility, normal morphology, and viability. These abnormalities seem to be directly related to the duration of mobile phone use, with longer duration to lower sperm quality”¹⁴⁷ However, SCHEER omits the conclusion entirely.

¹⁴⁵ https://www.jstage.jst.go.jp/article/tjem/248/3/248_169/_article

¹⁴⁶ <https://www.frontiersin.org/articles/10.3389/fphys.2021.732420/full>

¹⁴⁷ <https://pubmed.ncbi.nlm.nih.gov/34384508/>

SCHEER also refers to a study by Santini et al. (2020), funded by the EU Horizon program. Again, SCHEER fails to mention the conclusion by Santini et al – which is in dire contrast to the working group’s biased opinion: *“Based on in vitro studies, there is a general consensus on the effects of EMFs from mobile phones, laptops, and other electric devices on human sperm quality with possible negative influence on fertility.* Instead, SCHEER casts doubt by focusing on that different experimental design were used in the included studies – and some of these designs did not show effects on the sperm. All studies using RF-EMF showed negative effects on sperm quality, except for one study which did not use relevant exposure. SCHEER fails to mention these facts, that strengthens the conclusions of the study, and show that there is no scientific basis for SCHEERs critique of the study.

Important studies omitted by SCHEER

SCHEER has not included a relevant scientific review from Panagopoulos (2021), which demonstrates adverse effects to germ cells from modulated (non-sinusoidal) RF EMR. Furthermore, the consistent evidence, showing that RF-EMR from telecommunication devices causes oxidative stress and DNA damage, corroborates the detrimental effects to germ cells (see our comment to section on oxidative stress and genotoxic effects). In accordance, the ICBE-EMF concluded in October 2022 that *“the adverse effects of RFR on sperm quality are likely due in large part to induced generation of ROS”* and that *“The effects of RFR on reproductive parameters in humans are consistent with results from experimental studies in animals and in vitro studies”*¹⁴⁸

Another review (Sterling et al. 2021), not mentioned by SCHEER, concluded: *“The EMR emitted by wireless devices may negatively affect TMSC [total motility sperm count], which is one of the better predictors of achieving pregnancies and impairs male fertility”*¹⁴⁹

Remarkably, one of the most comprehensive systematic scientific reviews was not at all mentioned by SCHEER: A scientific review of the available evidence conducted for the EPRS, European Parliamentary Research Service in 2021. The scientist’s conclusion is in stark contrast to SCHEER’s opinion on reproductive and developmental effects: *“(450 to 6 000 MHz): these frequencies clearly affect male fertility and possibly female fertility too”*.¹⁵⁰ This comprehensive systematic (scientific) review considered peer-reviewed articles in English, published from 1945 to January 2021, using validated methodologies for evaluation of the science.

SCHEER ignore this review and the review’s conclusion although one of its author’s, Fiorella Belpoggi, is listed as a contributor to the SCHEER report. Still SCHEER claims that there were no minority opinions, although the conclusion from Belpoggi is clearly in contrast with the SCHEER conclusion

¹⁴⁸ https://icbe-emf.org/wp-content/uploads/2022/10/ICBE-EMF-paper-12940_2022_900_OnlinePDF_Patched-1.pdf

¹⁴⁹ https://www.researchgate.net/publication/357361645_The_effects_of_wireless_devices_on_male_reproductive_health_A_literature_overview

4. Conclusion

In this report, we have documented how economic and political interest influence the risk management of the public health threat from wireless telecommunication in the EU. The opinion report is clearly biased. The positive attitude to the ICNIRP 2020 guidelines benefits the telecommunications industry but is detrimental to human health and the environment. Those guidelines allow levels of exposure that is far above those that are known to cause harmful effects, and the proposed changes will allow for the increased exposure and high intensity beams from 5G. There are, on the other hand, no scientific studies that show that chronic full body exposure of humans to 5G and/or 4G base station radiofrequency radiation, for instance, at levels proposed by ICNIRP, does not cause disease in humans and does not cause harm to the environment.

The European Agencies were established to ensure the economic and political independence in risk assessment, to ensure a sound foundation for the risk management at the political level in the EU. It is the task for the EEA to form expert groups that are free of economic and political interests in order to conduct scientific risk assessments of potential public health risks and environmental risks.

The SCHEER opinion report breaches the principle of a clear delineation between risk assessment and risk management in the report. The SCHEER group does not live up to the criteria of excellence and independence, that are crucial in risk assessment.

Our report further documents the consequences of the lack of excellence and independence, in the low quality of the assessment of science in the field. The report is in many parts unscientific and extremely biased in the evaluation of the current scientific evidence of health risks. It cannot be used as a basis for decisions on new exposure limits for the prevention of harmful health and environmental effects.

The SCHEER report should be dismissed and a new objective scientific evaluation of the risks to health and the environment from the radiation from wireless communication must be undertaken by competent experts without conflicts of interests and ties to industry. The relevant EU body to manage the new evaluation procedure is The European Environmental Agency.
