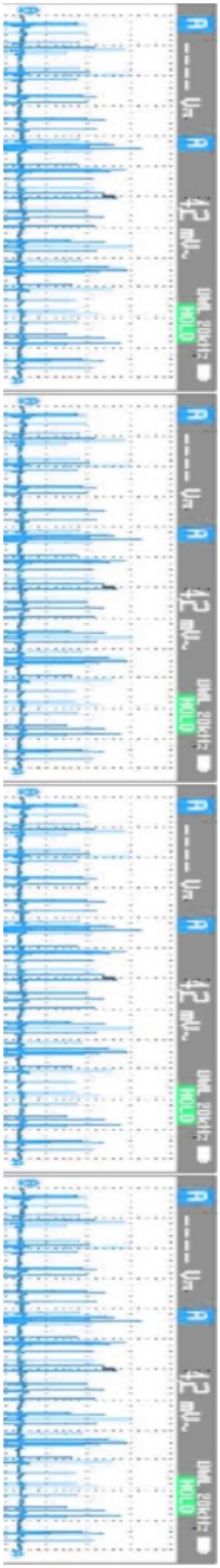

SMART METERS, DIRTY ELECTRICITY, PULSES AND HEALTH

BY

EINAR FLYDAL

AND

ELSE NORDHAGEN

Health complaints from the AMS meters that are now installed by the thousands in homes are no longer surprising. Today's knowledge of pulsed electromagnetic radiation and “dirty electricity” tells us that they were to be expected. There has been no shortage of warnings. We explain physics, electro-science, biology and industry strategies in words and pictures, and we reproduce research and expert legal testimony.

We also report on measurements we have had carried out on Aidon and Kamstrup meters, and explain why many people get sick from them. We don't have believe in anxiety and superstition as the causes behind these illnesses. Solid research results and hard facts suffice.

Electrical environmental pollution of the kind created by AMS meters is a new, major environmental issue. The topic is rising internationally on the political agenda from an invisible position - in step with the "green" ideal of "full electrification".

This book is designed to be read both as a popular science textbook, for lawyers to be able to cut and paste quotations and references for their pleadings, and for journalists, researchers, lay people and those who write readers' letters to newspapers.

Einar Flydal, cand. polit. & MTS (political scientist and telecom strategist), worked within the ICT sector, including; as researcher and senior strategy advisor at Telnor ASA and as university lecturer at NTNU. Since he retired in 2011, he has become an important critic of Norwegian radiation protection policy.

Else Nordhagen, PhD. Scientist in informatics, worked with ICT as a university lecturer, consultant, researcher in apps and as a senior researcher at SINTEF and Telenor ASA. Since she became ill in 2017, she has collaborated with Flydal on radiation, the environment and health damage.

Smart meters, dirty electricity, pulses and health

by

EINAR FLYDAL and ELSE NORDHAGEN

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(The Association for EMF reform)

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The Norwegian association *Foreningen for EMF-reform* is a small not-for-profit registered NGO, providing information on the domain of health and environmental impacts from electromagnetic fields from digital technologies. All donations are welcome and go towards research and campaigning. To make a donation, please visit: http://paypal.me/EMFreform

For further requests, please contact the publisher/authors via email: post@emf-reform.org

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This book is the second of two. The first one is:

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Keywords: smart meter, AMS, radiation, pulses, dirty electricity, transients, health, electromagnetic fields, microwaves

The cover shows a log of carrier wave amplitudes and pulses from an Aidon AMS smart meter. Spacing between dotted lines: two seconds. (Log performed by EMF Consult AS)

Preface to the English edition

The book is designed to be read as a textbook and for anyone in need of knowledge and sources – by lawyers to be able to cut and paste quotations and references to their pleadings, investigative journalists, scientific researchers within radio science as well as biology and medicine, and for lay people and those who write letters to the editor in the local newspapers. Therefore, you may download the entire book for free as PDF. See links on the colophon page.

The book is translated from Norwegian and slightly revised: Originally, it was compiled spring 2021 to serve as documentation and collection of sources of scientific and other evidence for a court case on health effects for the deployment of “smart” electricity meters in Norway.

The book is designed to be read as a textbook and for anyone in need of knowledge and sources – by lawyers to be able to cut and paste quotations and references to their pleadings, investigative journalists, scientific researchers within radio science as well as biology and medicine, and for lay people and those who write letters to the editor in the local newspapers. Therefore, you may also download the entire book for free as PDF. See links on the colophon page.

For the most technical parts, primarily Parts 4 and 5, we have received important contributions from former sound studio owner and engineer Erik Avnskog, now with FELO (Association for Electro-Sensitives), who to protect his own health had to dig deeply into the technicalities of pulses and dirty electricity, and from Odd Magne Hjortland, head of the EMF measurement and consultancy company EMF Consult AS, a former ship automation engineer who one day discovered that his dog’s whining systematically halted when he turned off the WiFi router. So then he started investigating the topic. They should have a big thank you! Still, we are responsible for the text.

Erik’s and Odd Magne’s personal stories are similar to our own: Einar is a retired social scientist (cand. polit. and Master of Telecom Strategy and Tech. Management), a researcher, strategy adviser and university professor on matters related to telecom and societal impact. He started to investigate the ecological footprint of telecom systems. Else is a retired ICT researcher (PhD), developer and serial entrepreneur who thought she would never get any ailments from anything ICT, until an AMS meter was installed in her home. Systematic investigations led her to the unexpected conclusion. For some years now, we have spent much of our time studying, translating and writing on the topic of EMFs, health and the environment.

Creating an English version has been a major undertaking. We are very grateful for the substantial help received with this major task! A few new references have been added, but original numbering maintained. Broken links and factual faults corrected, many references abridged and shortlinks added for the reader’s convenience, and passages have been improved as well as revised to make them less specific to a Norwegian setting.

Much material still refers to Norway and to our own writings, where further material is referenced. Still, we hope that these Norwegian only references provide valuable examples and might spur hunting for parallels in other countries. We also hope that not too much is lost in translation, and apologize for any passages not being idiomatic English.

The new pattern of morbidity long since observed by environmental medicine practitioners is about *environmental stressors* and the interaction between them. They provoke energy loss disorders, inflammatory disorders and weakened immune systems. The diagnoses spread out in a wide range – and are found not just in people, but in all life – both acutely and over time.

Pulsed microwave radiation and *dirty electricity* have long since taken their place among these environmental stressors. It is to document these two parts of the puzzle that we prepared the Norwegian original during winter 2021/22 for a case in court on electricity smart meters:

In 2018, one of us, Einar Flydal, published the book *The smart meters, the law and health.*[*] In addition to a report written by a law firm on the legal aspects of the introduction of AMS (Automatic Metering Systems) / smart meters in a Norwegian juridical context, the book gave a broad overview of the knowledge status on health effects from microwave radiation in general, and from AMS meters in particular. It became an eye-opener and a textbook for many: All of a sudden, it became understandable that quite a few people get sick from such microwave transmitters, even if the signalling from them is far weaker than the maximum exposure values recommended by the Norwegian Radiation Protection Authority (NRPA) – as well as by RPAs of the many countries which have adopted the standards by and large derived from an American physicist oriented radiation hygiene tradition. Also, it became understandable that the Radiation Protection Authority's advice and assessments could not be trusted, as even *weak pulsation* may have a strong biological impact. This was briefly discussed in the book. Towards the end of the book, the strange and alien phenomenon of *dirty electricity* was mentioned almost in passing.

Now, in the spring of 2023, the vast majority of the 2.9 million smart meters for power – AMS meters – which were to be installed in Norwegian homes, are in place. The Norwegian Water Resources and Energy Directorate (NVE) ordered the grid companies to install new AMS meters at all measurement points, but at the same time permitted exemptions from AMS – in practice from the transmitter part. A documentation of significant inconvenience – in practice a doctor's certificate of health problems from the radiation was demanded. The Directorate of Health then forbid doctors to issue such certificates, and issuing such certificates was also opposed by the Norwegian Medical Association, since doctors are not familiar with problems from such exposure, they are so difficult to observe and EHS – electro-hypersensitivity – is not an accepted diagnosis by the Norwegian heath authorities. The exemption option has also been under-communicated and exemptions “punished” with a separate fee. Nevertheless, by third quarter 2020 some 7,000 households were exempt with a medical certificate – allegedly because of health problems from such radiation.

In the wake of the AMS introduction, many have reported acute health problems. The ailments have often come completely unexpectedly, even when not knowing a new meter had been installed in the home, or in neighbouring houses or apartments. Such effects are today well explainable based on today's specialist knowledge, as this book shows. And the mechanisms are increasingly better understood.

However, some people claim they get acute health problems *even when the transmitter is removed*. This has been even more difficult to accept and to find reasonable, and has been understood as a clear sign of superstitiousness or mental disturbance. However, this too has its explanations in physics and biophysics. The key is *dirty electricity*.

Pulsation and dirty electricity from AMS meters are claimed by our health and radiation authorities not to possibly cause health problems or injuries. As with the microwave signals, claiming otherwise would imply contradicting the national radiation policy. This book proves them wrong. And the prevalence of the diffuse symptoms typical from such exposure is becoming greater as the “full electrification” of society progresses. We show that such symptoms present themselves as expressions of health problems stemming both from the new meters, whether with or without a transmitter, as well as from the many other sources of electrical pulses and dirty electricity in our surroundings.

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* “Smart meters, law and health” (Z-forlag 2018), written by the law firm Advokatfirmaet Erling Grimstad AS and Einar Flydal, downloadable from https://bit.ly/3BI97h3

In this book we bring together information from textbooks, research papers and expert opinions in court, and we report on measurements we commissioned professionals to undertake. We explain physics, electro-science, biology as well as industry strategies. We don't need to draw in anxiety and superstition. Tangible knowledge and solid research results – without psychologisation – do the work.

The protests against the AMS meters and against other radiation sources that destroy our living environment, are now happening all over the world – and increasingly often in the courtroom. The reasons are the same: People get sick from them – dogs, birds and insects alike.

It is reasonable to assume that as a result of the AMS meters, a significant number of Norwegians are tipped over from healthy to ill without any idea of what the cause might be, and that similar situations appeared in other countries with the introduction of AMS meters. It is our hope that this book should reach them, as well as the ones who introduce such meters. There, you readers have an important mission!

This entire field of biological impact from EMFs is a huge puzzle. Hopefully, with a little patience, this book will help you bring some of the less known pieces together!

Einar Flydal and Else Nordhagen, 24. May 2023

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1. Introduction

This book provides background information on harmful health effects from pulsed electromagnetic radiation and "dirty electricity", and shows why and how the current regulation of such radiation is not sufficient to protect against harmful effects from such, specifically in connection with AMS* meters (smart electricity meters). We show how the AMS meters produce *pulsed electromagnetic radiation* of various kinds and in several ways and how this affect people's health (Fig. 1).

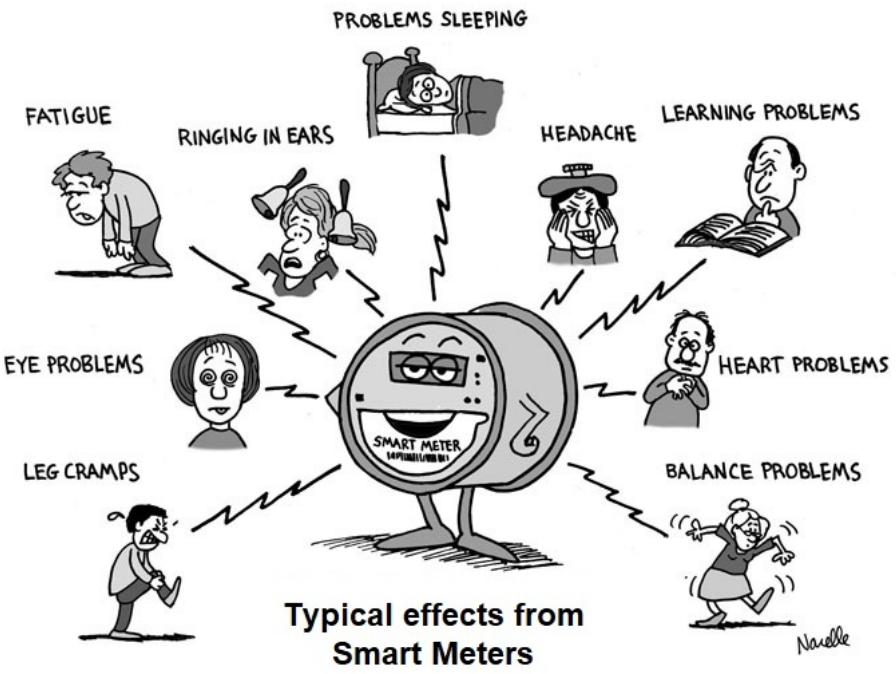

Figure 1: One of the many representations of typical effects from AMS meters (Source: With thanks to: www.emfsafetynetwork.org and www.narellecartoons.com)

The book is designed to provide a necessary basis for understanding in order to assess the health and environmental, technical, political and moral aspects that the topic raises, as well as providing an insight into historical causes and traditions that form the basis for today's radiation protection regulations.

This book provides technical as well as biological descriptions of the interaction between electrical current, pulsed electromagnetic radiation and biological reactions. They show that it is not unreasonable to expect that pulsed electromagnetic radiation and dirty electricity can produce a number of *biological effects* of the kind which is so frequently reported where AMS meters are introduced – such as ringing the ears, tinnitus, dizziness, visual disturbances, fatigue, headache, impaired concentration and insomnia. On the contrary, it is reasonable to expect such effects in some of the population, as well as more severe morbidity over time.

To substantiate such claims, peer-reviewed research, expert opinions, major studies and reports, clinical experiences, journalists' and other mediators' descriptions, and some personal experiences are referred to and discussed.

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* *Automatic Metering System.* Alternatives include: AMI – Automatic Metering Infrastructure (US, Canada, Australia), SMETS1 & SMETS2 – Smart Meter Equipment Technical Specifications 1 and 2 (UK)

We approach the material from several different angles. That means there is quite a bit of repetition. Some of them are done intentionally: It should be possible to only read parts of the book.

The format – with the many quotations and repeated full references to the same sources – have been chosen on purpose to make it easy to copy out parts.

In such a cross-professional and comprehensive presentation that has been created in a short period of time, its is inevitable that there are errors. We hope they do not overshadow the overall picture.

- -

We have chosen to use the popular term “dirty electricity” as a technical term, as it has become a common expression to denote several more precise forms of “noise on the network”, and is also used in professional and scientific papers. Further explanations of what this expression means will be given in the text.

The more technical readers who want a most direct, electro-technical explanation, are suggested to go directly to Part 3, perhaps afterwards supplementing it with Parts 1 and 2 afterwards.

1.1 What are AMS meters – and what's the problem?

AMS meters are electricity meters that are part of a network of automatic metering systems that perform automatic monitoring, reporting and remote control of the power supply. Groups of AMS meters form small mesh networks that communicates via large networks with the network operator’s operating systems for AMS, as shown in Figure 2. As participants in the mesh network, all AMS meters send radio signals at certain intervals between themselves. Some, such as Aidon meters, send short signals so often – approx. every 0.6 seconds – that in a biological context the signalling may be considered to be continuous, although intermittent.

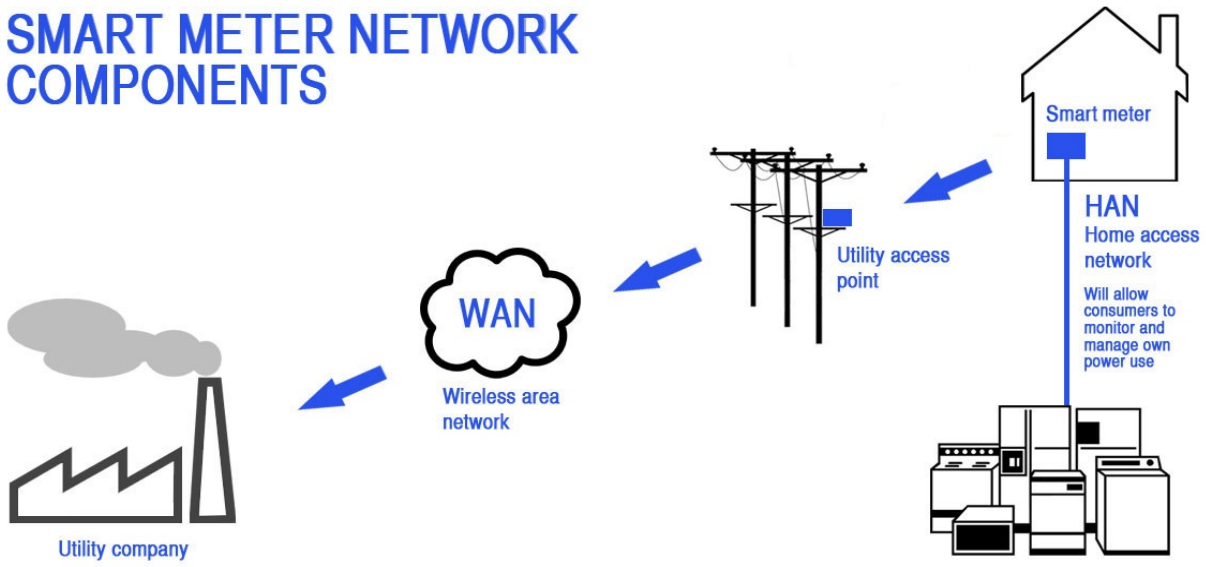

Figure 2: The role of AMS meters: reporting and remote control, and central for managing the home network of “smart” things (From Sierck 2011, see Ref. 112)

All AMS meters contain a power supply and electronic components that creates “dirty electricity” and which thus, via the wiring network, spreads pulsed electromagnetic radiation throughout the house. These pulses in the power grid have the same characteristics as digital wireless communication in relation to *biological effects*.

Such scattering patterns are not taken into account when determining the radiation protection exposure limits in Norway: They are based on guidelines that only take into account *the heating effect* of electromagnetic radiation – thus named *the thermal paradigm*:

There are two main positions within radiation protection with regard to so-called “weak” or “non-ionizing” radiation. One is based on the *thermal paradigm*, while the other is based on the idea that electromagnetic radiation can also produce so-called *biological effects*. These occur at far weaker radiation intensities than required to cause damage by heating.

While Norway, the USA and some other Western countries' radiation protection regulations are based solely on the *thermal paradigm* and recommend roughly coincident, high exposure limits, large countries such as India, China and Russia take *biological effects* into account, as well as the *precautionary principle*, in their regulations, and have set exposure limit at one hundredth of Norway's or lower. (Many countries hail both: the “Western” limits, and specific restrictions.)

These two different positions also include different choices of assessment criteria to recognise which effects are considered “scientifically proven”, and whether the *precautionary principle* should be used as a basis when some effect cannot be determined with absolute certainty. Scientists do find, and do not find, *biological effects* from pulsed electromagnetic radiation, as well as for all other kinds of radiation. The sheer numbers of findings vs. “non-findings” cannot be the only criterion of truth.

The background for such differences in recognised injuries and assessments of findings resulting from EMFs, as well as the consequences of these differences, are presented in this book.

Studies of which properties of electromagnetic radiation give the greatest biological effects, i.e. at weak, non-thermal exposure levels, suggest that the most important characteristic may not be the strength, but the pulses – or pulsation – albeit a somewhat loose term that, like *dirty electricity*, is used for any abrupt variations in the electromagnetic field. Pulsation and *dirty electricity* denote properties of electromagnetic radiation completely different from the strength, or the *energy intensity*, which is the characteristic measured by all ordinary exposure measurement devices. It is the energy intensity and the *duration* of it, which together with the heating ability of what is exposed, which determines the *heating potential*. Therefore, it is the heating potential that is used as a basis for the recommended exposure limits on which the regulations of “non-ionizing” radiation are based. Pulsation is not captured by this measurement method.

The drama lies in the fact that the *biological effects* of pulsed radiation are significant and for some quite dramatic and acute, and that pulsing is used by all digital wireless communications to encode data to be transmitted, wirelessly or wired, under the term of *signal modulation*. This is how content is transmitted. Modern computer equipment and energy-saving equipment create pulses, too, even without radio transmitters. These pulses are sent, as part of what is labelled *dirty electricity,* out on the wiring harness in the house. The wires then act as antennae that emit the pulsed electromagnetic radiation in their electromagnetic field. These pulses can be measured in these fields surrounding the wires – in practice throughout the house.

In an increasing number of countries and areas, the *thermal paradigm* is now being challenged in court cases. This book refers to several such cases where the plaintiff claims to be harmed by pulsed electromagnetic radiation weaker than the “Western” exposure limits, which we shall hereafter refer to as the ICNIRP/WHO recommendations.

The book also documents how businesses and others players within this field, who benefit from high exposure limits, have used, and continue to use, the same methods for promoting their interests that we got familiar with in the disputes over tobacco, asbestos, pesticides and other health and

environmental matters where biological impacts and the *precautionary principle* stand in the way of commercial, military and/or political interests: Knowledge is undermined, counter-research is produced, researchers are attacked personally.

This book explains why the AMS meters of the types installed in Norway, placed in the fuse box inside the homes, constitute very significant sources of pulsed, electromagnetic radiation – and of health problems.

From most other sources of such pulses, you may opt out, or remove or shield yourself. Protecting yourself from the harmful effects of an AMS meter is not easy if you want to have electricity in your home.

Hence, those consumers who are acutely affected, are scattered – they are by themselves, isolated, with symptoms differing, and often – may be mostly – without understanding the cause behind. Even when understanding the cause, they often do not have the resources to investigate, map and take measures to protect themselves or correct for the dirty electricity that is created in the electrical grid from outside the house, or by various internal sources.

Still, inside a household, if informed, people can control what they themselves have connected internally in their home. Mandatory introduction of meters that supply the dirty electricity to the house's electrical system deprives consumers of this control, and enforces them into a situation that only the few are able to understand and to do anything about.

Particularly striking and tragic are the cases of those who are particularly sensitive to electro-magnetic fields (EMF), suffering from acute health problems when exposed. But the consequences might be just as serious when it comes to the health and environmental damages from long-term exposure. Hence, also for the vast majority, not experiencing any acute reactions, we must expect increased morbidity in the longer term. These effects, although well enough studied to justify changes in radiation policies, have so far generated little interest among politicians, researchers and the media.

This book shows that several different technical characteristics of the meters, as well as radio physics, biophysics and medical experience make it reasonable to expect that the AMS meters will have biologically harmful effects. This is not new, but a conclusion easily derived from general knowledge that has not been taken into account in current radiation protection regulations.

1.2 What claims do you find evidence for in this book?

Here follows a very compact summary of the claims which are proven in this book. It is given in a form intended for lawyers and others who may then go into the details of the claims and the basis for them, and extract references. By "proven" we here mean in a legal sense, not a scientific one: In the world of empirical science, one can never provide definite proofs, only evidence that make claims good, better – and thereby increasingly plausible.

The book contains substantial documentation on each topic in the form of explanations, illustrations, quotations and sources that provide proofs for the following claims:

1. AMS meters with radio transmitters create an environment where the smart meter's microwave radio communication – alone and/or in conjunction with other environmental stressors – increases the risk of health problems and disorders – acutely and over time.
2. Even when the meter's transmitter is removed/disabled, the cabled connections create voltage noise and harmonic noise – in the book referred to as dirty electricity – an

environment that – alone and/or in combination with other environmental stressors – increases the risk of health problems and disorders – acutely and over time.

3. This (points 1 and 2 above) happens regardless of whether the meters stay within technical requirements for EMC (electromagnetic compatibility) and ICNIRP/WHO radiation protection limits, or not.

4. The two phenomena – microwave radio communication and the dirty electricity – are closely related physical phenomena that in both cases will be present in the home where the meter is placed, and must in normal situations be expected to be present with energy intensities (normally called “strength”, and measured, among others, as nT, V/m and/or $\mu W/m^2$) which in relevant, published, peer-reviewed research have been found to have an adverse effect on biological material and thereby give an increased risk of health problems and disorders – acute and over time.

5. Such adverse results have been established through repeated, independent research experiments, in laboratory tests and supported by experiments in clinical trials, and by epidemiological research. However, the findings are not consistent with energy levels, as the mechanism is not just energy intensity, but other factors, such as pulses.

6. Such results constitute a clear and overwhelming majority of the number of primary studies, compared to studies that make “non-findings”.

7. Such results are established through an extensive number of scientific literature reviews.

8. The current recommended exposure limits are formulated through guidelines that specify reference values calculated only to protect against rapidly occurring health damage from *acute heating* (at radio frequency (RF) ranges) and nerve stimulation that causes hallucinations, sensory impressions (low frequency (LF) ranges). They also contain a wide range of exceptions as to what are considered health effects against which the reference values are supposed to protect.

9. Pulsation – a generic term that includes various forms of variation of electromagnetic fields, including *signal modulation*, the frequent *power outages* from SMPS-type power supplies, *harmonics*, etc. – has been solidly demonstrated in scientific research as particularly bioactive, but is not taken into account in the ICNIRP/WHO current guidelines and recommended exposure limits, since equipment normally deployed in the consumer market and industry does not cause heating at the safety distances specified for the technologies.

10. Pulsation in its many various variants, known from research to have a high biological impact, is present both in the AMS meters' microwave radio signals and in the dirty electricity caused by them and distributed over the electricity wires.

11. Within research in medicine and biophysics, there are widely accepted explanatory models for how environmental stressors – including microwave electromagnetic fields – affect biology and create such widely varied effects as are observed in epidemiological studies.

12. The guidelines from ICNIRP/WHO do not take account of, but reject and/or neglect, the scientific research findings mentioned above when proposing their “reference values” for setting recommended maximum exposure limits.

13. The reference values (to protect against heat and nerve incitation) stated in the ICNIRP guidelines, and recommended by the WHO, are transformed into generally recommended

maximum exposure limits (against all sorts of non-ionizing radiation) through evaluation process chains shaped as sample-based *scientific literature reviews*.

14. These literature reviews systematically conclude that the aforementioned scientific findings of biological effects should not be given weight as they are – it is claimed – not sufficiently assured ("substantiated", in the terminology of ICNIRP). Thereby they legitimize the exposure limits recommended by ICNIRP/WHO, i.e. the thermal paradigm. These reviews are based on highly criticised evaluations carried out by committees that are under heavy international criticism for their industry affiliations, bias, professionally weak evaluations, relying on "negative proof" by relying on research finding no harm from sub-thermal exposures, the use of "mechanistic" evaluation criteria that may suit simplistic physical reasoning but are not suitable for the investigation of effects on complex dynamic biological systems, and criticized as well for relying on failing judgements of what should be considered "safe enough". These literature reviews demand absolute proofs that cannot be obtained from empirical research in biology and medicine, and on inclusion criteria that provide endless opportunities for rejecting any findings not caused by heating, thereby delaying the introduction of more restrictive measures.

15. These assessments are in sharp conflict with the vast majority of the findings within independent scientific biological and medical research in the field. Such research makes positive findings of biological effects. To rely on such research is, in its own right, far more scientifically sound than relying on scientific research that does not make findings.

16. Claims put forward by the Norwegian RPA that the radiation from AMS meters is "weak" and "rare", have been demonstrated to be based on confusing concepts (as "weak" may just mean "sub-thermal" in the radiation protection jargon) and on mixing up measurement standards (e.r.p. vs. e.i.r.p.).

17. Claims that exposure to such radiation is harmless, contradict established research and current norms for HSE and consumer protection, and are even in conflict with the documents on which Norwegian recommended exposure limits for exposure are based, as these documents express a certain uncertainty about non-thermal effects.

18. The roll-out of AMS meters was therefore done in an irresponsible manner. In Norway, it was done without any prior (not to speak of independent) impact assessment of the health and environmental aspects of the chosen technologies.

19. AMS meters impose biological disturbances on the living environment and its residents, as they cannot remove these environmental stressors, i.e. the meters' microwave communication and dirty electricity, without simultaneously losing their electrical power, or, at best, incurring significant costs in shielding and filtering equipment that they have normally never heard of, are ignorant as to how such equipment works, or where to find it.

20. Some people get acute health problems from these meters, even when the transmitters have been removed/deactivated.

21. Some of these people have acute health reactions and/or health problems that belong to the clusters of symptoms (syndromes) which in peer-reviewed, published research have been found to be caused by, or stimulated by, exposure to man-made electromagnetic fields.

It follows that the forced installation of new meters – with or without active microwave transmitters – is ethically unjustifiable and unfortunate from a public health and social responsibility perspective. Given the consequences for the environment, it is not ecologically sustainable.

This book does not go into further into questions related to law. On the other hand, it is full of food for thought for lawyers, as there are plenty of laws and regulations relevant as soon as the damage created is recognised.

2. What the AMS meter case is all about

In Chapter 2, we give a broad presentation of the topic, before going into the technicalities.

2.1 The crux of the matter seen from the point of view of electricity customers

The technical equipment in question is an *AMS (Automatic Metering System) made for pulse-intensive microwave radio communication* for remote reading and remote management of meter data. Such meters also contain a *pulsing power supply* (*SMPS / switched mode power supply*) and various *electronic processors*.

It is well known in the electricity industry that such equipment creates EMC problems, i.e. problems with electromagnetic compatibility issues. It is less well known, and less accepted, that EMC problems also occur in humans and other forms of life, and that extensive research shows significant health problems and harmful effects on biological material.

From the point of view of the electricity customers, and stripped of juridical, medical and technological wordings, this book is about the right to protect one's own living environment, and not being forced to pollute the surrounding environment:

Electricity customers buy electricity from an electricity provider and a grid/network provider. The buyer(s) require the right to prevent the network provider from installing technical equipment that pollutes the dwelling with an environmental toxin that has been clearly proven in research for many years to put bio-organisms, including humans, under biological stress, inflicting health and environmental problems on them, or, at least, an increased risk, acutely as well as over time.

In all countries where electricity companies have introduced such meters, the same health problems have emerged, with much the same symptoms. Court cases have been held, and following threats of legal proceedings, the introduction has been made voluntary. Norway, Denmark and Sweden are, to our knowledge, the only countries where installation of meters with wireless communication has been made mandatory: In several other countries, compulsory introduction has been attempted, but has then been converted to voluntary, following legal proceedings or threats of such.

As far as we know, Norway is the only country where a medical certificate is required to opt out from the AMS installation. At the same time, health authorities and medical associations have been given clear notice that doctors should not issue such certificates. (Many have still done so.)

The electricity buyer(s) are affected by this, partly in the form of acute health problems and partly in the form of an increased risk of acute and/or health problems over time. Several cases have been reported where people have become permanently electro-hypersensitive after the installation of AMS meters, envisioning life-long disability. Some can simply no longer live at home, but stay more or less permanently in a cabin, or sleep in their car on a remote parking lot, etc.

In Norway, no consultations were carried out in advance, nor any follow-up surveys from the grid providers, the utility authority (NVE), nor the health authorities. The only Norwegian data sets on health effects from AMS, are therefore a collection of approximately 150 individuals' anecdotal self-narratives about health issues based on their experiences with EMFs, in part also AMS meters:

> Ref. 1: Smart meter self-reports, https://bit.ly/3jhPSp0*

Then there are a few more or less, random surveys. Jeanette Stamper made a small (and unscientific) survey on her Facebook page (communication from JS to author EF by e-mail).

* Full link: https://einarflydal.com/smartmaler-historier/

Jeanette insists she got spasms (before she moved to some other location) exactly in sync with the pulses from the neighbour's meter, even after that meter was set to a changed pulse rate (verifiable with a simple meter). Jeanette asked participants in a large Norwegian Facebook group she manages to record whether they had noticed changes when the AMS meters were installed. The result was as follows (number of people):

- Sleep problems: 150
- Headache: 142
- Ringing in the ears/tinnitus: 124
- Dizziness: 94
- Burning and stinging sensation in the skin: 85
- Muscle twitches / twitches around the eyes: 64
- Stomach and intestinal problems: 43
- Problems with the heart: 40
- Other effects: 63

These are results that are reasonably consistent with reported ailments in Figure 3, from:

> Ref. 2: The Biological Effects Of Electromagnetic Radiation (Microwaves), presentation at the Australian Radiation Protection And Nuclear Safety Agency (ARPANSA) ElectroMagnetic Energy Reference Group (EMERG), November 2015, DOI: 10.13140/RG.2.2.28585.47205, foil no. 54

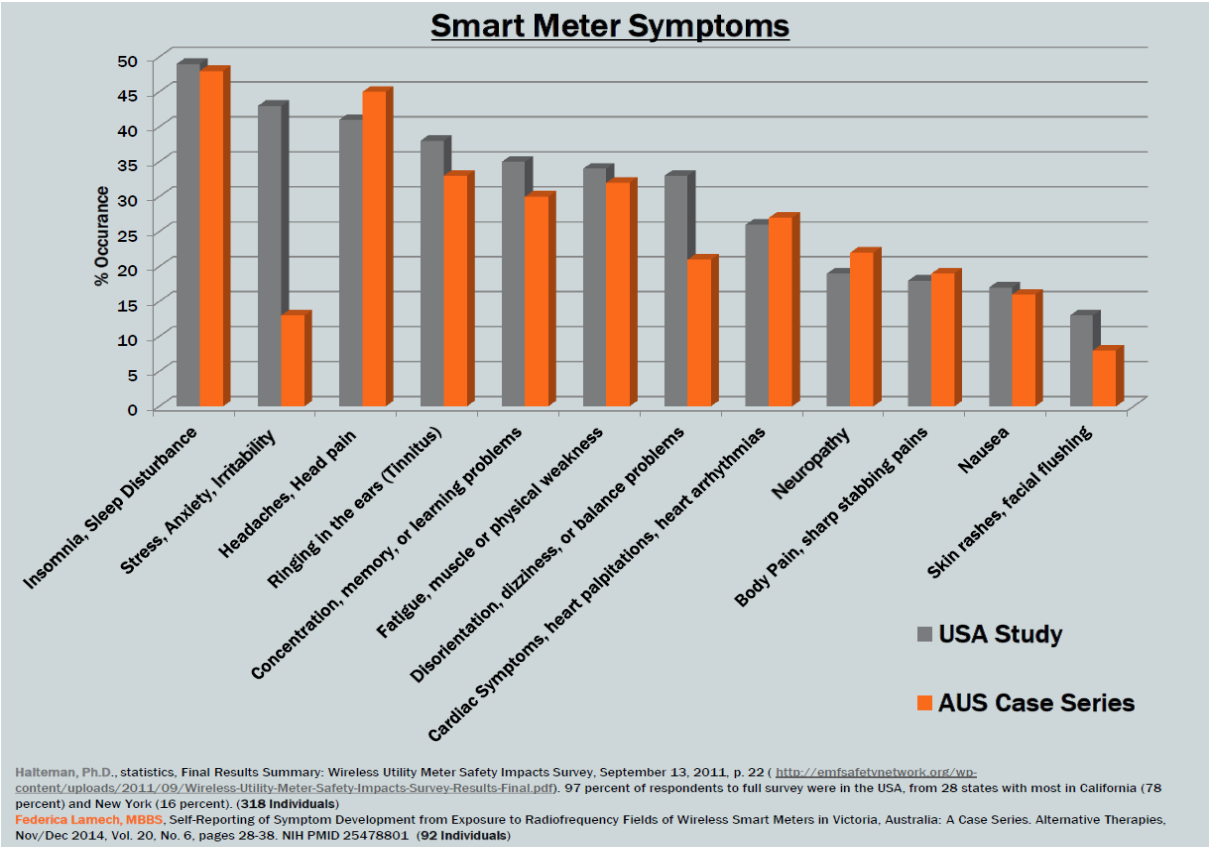

Figure 3: Some self-registered acute effects from AMS/smart meters USA and Australia (Weller 2015)

In Figure 3 we see from left to right: 1. sleep disturbances, 2. stress, anxiety, irritability, 3. headache, 4. ringing in the ears (tinnitus), 5. concentration, memory, learning difficulties,

6. exhaustion and physical impairment, 7. disorientation, dizziness, balance problems, 8. heart problems, 9. neuropathy, 10. body pain, 11. nausea, 12. skin rash and facial flushing.

Based on experience in other countries as well as based on research and medical accounts, the health problems were predictable. On the same scientific basis, it is foreseeable that there will be more long term health effects in a significant, however difficult to estimate, proportion of the population, as we shall see in the following.

The following questions thus arise:

- To what extent does the buyer have the right to object to such equipment, and at the same time have the right to have electricity delivered?
- What mitigating measures are required for people who experience acute health problems and for the population and the living environment in general?

Related to this are the following questions:

- Can the risk of injury be detected and proven?
- What damage level should be considered acceptable to the customer, and what risk acceptable, when having electricity supplied from the grid/network provider?

2.2 A management network based on a distorted risk picture

Here is described the emergence of a classic situation during paradigm shifts: A combination of actors, institutions, rules and interests that do not understand, or do not take into account, that they lack recent, central knowledge challenging their views on the matter. In this case, the lack of biological/medical knowledge constitutes a threat to public health and to the living environment. We present here how the existing paradigm is challenged by such new knowledge.

For a slightly more comprehensive but still simplistic description of how radiation protection is built, organised and works through international bodies, we refer to Part 2 in the predecessor of this book:

> Ref. 3: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3*

In both that book and the present one, “radiation” refers (when otherwise not stated) only to “non-ionizing” radiation – radio waves and the fields emanating from electricity networks or equipment. There are numerous other sources in English on the topic. A listing here is outside the ambitions of this book.

2.3 A complex network of standardisation bodies

As part of the increased use of electricity, a complex *network of bodies and regulations* has emerged at an international level, at the regional level level and at the national level: These bodies are engaged in setting standards or making use of them. Standards, also called *norms* or *guidelines*, are key to creating markets – or to delimit them, to increase productivity, to improving or deteriorating HSE in the workplace, to world trade and economic growth – and to economic expansion or trade wars as well as to strategic weapons development. The battles over standards are therefore struggles

* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

driven not only by technical and legal experts, but by lobbyists, strong interest groups like industries and the military, and by politicians.

Hence, behind the beautiful speeches about how standards unite the world and create welfare, there are not only neutral actors with global agendas for peace and welfare, but also strong interests that push the words about social benefit in front of themselves in their fight for quite different agendas:

The track width of the railways, the pitch angle of the threads on screws and nuts, liability for injuries at the workplace, limits for caffeine content in sugary drinks, the definition of a word like “pandemic” – can have huge consequences for defence, politicians, business, workers' organisations and for healthcare workers, and for handling customs and taxes, just to name a few.

This is also the case in radiation protection. We will see in this book that the complex network that shapes the standards followed by Norway in this field is working in such a way that the standards ensure maximum leverage for commercial actors, and correspondingly poor radiation protection for the population: The standards protect only against damage from overheating.

Once standards have been adopted, the administration must translate them into laws and regulations and enforce them. The business sector or other actors will have to implement them in their organisations, e.g. in their products and processes. The trend over many decades has been that more and more international standards are being created, and that the nation-state's own administration is increasingly becoming an office for dissemination of supranational or transnationally adopted standards on which they just put their stamp – after (more or less) automatic adoptions by national political bodies.

Within radiation protection, we have a number of certification schemes and requirements, including requirements for maximum exposure for people in working life (a set of regulations which are managed by the Norwegian Labour Inspection Authority), and recommendations on maximum exposure to non-ionizing radiation for the general population, which is managed by The Directorate for Radiation Protection and Nuclear Safety (DSA). From here on in this book, the topic is radiation protection for the general public, not for working life. (Even though the EU regulations for working life are based on the thermal paradigm, too, there are some differences).

There are requirements for electrical equipment and devices with transmitters in a range of laws and regulations, including *the Product Control Act and the Product Liability Act, the Radiation Protection Act, the Radiation Protection Regulations* and the *Free Use Regulations*. These are formed within the framework of international conventions and agreements, including the CE scheme, an EU certification scheme based on manufacturers' own declarations about the product they wish to have approved:

You submit the declaration, and voila! You are approved through an approval scheme which places all responsibility on you as the producer. This applies also for AMS meters. They are approved through the CE scheme and various other European standards, and can then freely “go on the air” as long as they respect the Norwegian Free Use Regulations' requirements for frequencies, transmission power and max total broadcast duration per 24 hours. That regulation is modelled on other countries' regulations of free unlicensed use, so one will find similar regulation in may countries. (The following references are to Norwegian laws and regulations.)

Ref. 4: (Norwegian) Product Control Act*

Ref. 5: (Norwegian) Product Liability Act†

* https://lovdata.no/dokument/NL/lov/1976-06-11-79?q=Produktkontroll

† https://lovdata.no/dokument/NL/lov/1988-12-23-104?q=Produktansvarsloven

Ref. 6: (Norwegian) Act on radiation protection and the use of radiation*

Ref. 7: (Norwegian) Regulations on radiation protection and the use of radiation (the radiation protection regulations)†

Ref. 8: (Norwegian) Regulations on general permits for the use of frequencies ("The free use regulation")‡

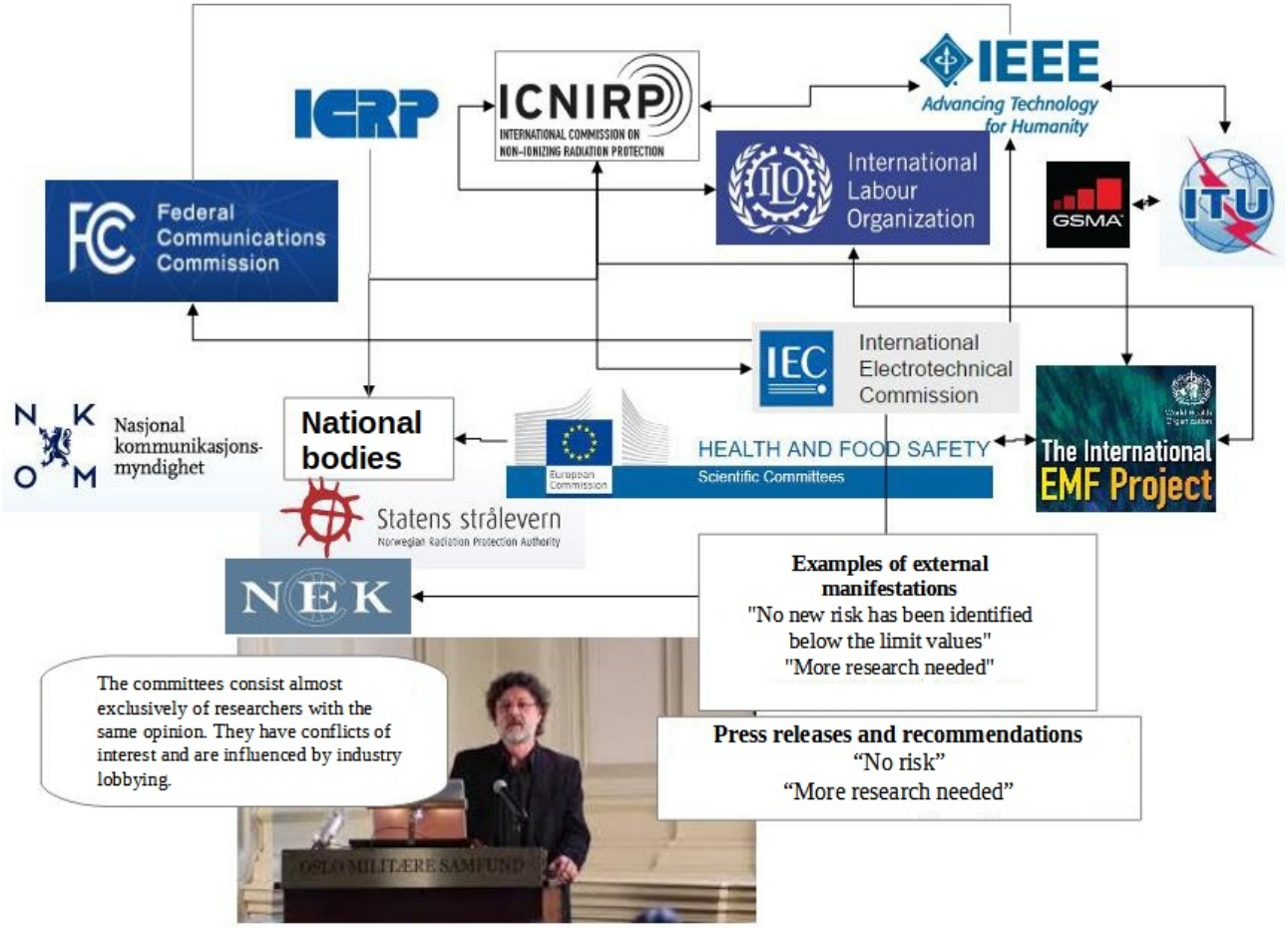

Figure 4: The network that shapes and implements the standards within the radiation protection that applies in Norway (source: Grimstad & Flydal 2018)

In this book, there is no need to go into detail in these regulations. The regulations are necessarily based on a perception of the risk connected with exposure to electromagnetic fields, what is *socially acceptable risk*, *who will bear the risk*, and what are *relevant and sufficient secure research findings about injuries* – called *knowledge status*.

The Radiation Protection Regulations are important for the regulation of AMS meters. Equipment with such "weak" radiation are classified as consumer products and/or licence free radio equipment (with reference to Norwegian laws: "The free use regulation" § 2e). Thus, such meters are exempt from any further regulation. The exposure limits have been set using calculations in the ICNIRP guidelines from March 2020. You will find the foundation ICNIRP in Figure 4.

* https://lovdata.no/dokument/NL/lov/2000-05-12-36?q=Str%C3%A5levernloven

† https://lovdata.no/dokument/SF/forskrift/2016-12-16-1659?q=Str%C3%A5levernforskriften

‡ https://lovdata.no/dokument/SF/forskrift/2012-01-19-77?q=Fribruksforskriften

> Ref. 9: ICNIRP, 2020. Guidelines for limiting exposure to electro-magnetic fields (100 kHz to 300 GHz), published ahead of print in: Health Physics, April 2020*

The ICNIRP foundation is constantly mentioned in this book: ICNIRP (*The International Commission on Non-Ionizing Radiation Protection*) is the most important policy maker for European radiation protection, and has therefore also a heavy impact in the rest of the world, apart from the USA, as ICNIRP mainly echoes the regulations on radiation protection made by the US based IEEE.

The ICNIRP is an independent, self-recruiting German foundation. The organisation has a very limited visible budget, is partly financed by business interests and partly by the German Radiation Protection Authority, in whose headquarters outside Munich ICNIRP has its facilities. ICNIRP has just one secretary employed and had, when one of the authors (EF) paid it a visit in 2015, just one single office room. The foundation is self-recruiting, hence consisting of professionals with same mindset. It has built up a small network of people which support ICNIRP's and the US standards body IEEE's view as to how and where the exposure limits for radiation protection should be set.

This view is called the *thermal paradigm*: According to this view, it is necessary only to regulate non-ionizing radiation so that it provides protection against acute heating from the radiation, as no other non-thermal effects have been proven. This applies to the type of radiation and the frequencies that are relevant for AMS meters. ICNIRP makes this delineation based on the claim that damage from exposures that are too weak to cause heating damage and has not been proven for “certain”.

No professional with divergent views from this has ever been recruited into this network – neither as an ICNIRP member, nor as an affiliate of the network. People from this homogeneous network prepare guidelines for radiation protection by specifying calculation methods for exposure limits to protect against damaging overheating, and criteria for what requirements must be set for scientific research – so-called *inclusion criteria* – in order for the results found to be accepted as a basis when assessing how strictly exposure limits should be set. Many countries in the EU and the entire Nordic region rely on the ICNIRP's guidelines without further ado, and thus set the country's exposure limits equal with the ICNIRP's reference values for protection against damage from overheating.

In these countries, ICNIRP members are normally placed in key positions in expert groups when assessments are carried out to explore whether the ICNIRP’s recommendations are still sufficient, most recently done in Norway in 2012 (with a more limited evaluation carried out now in 2022-23).

> Ref. 10: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012†

Their findings are based on the conclusion that only the ICNIRP network's own research is good enough to satisfy the criteria they have set themselves for acceptance of research results. Any research that finds harmful effects from non-thermal radiation exposure, i.e. at energy intensities not producing heat, are discarded.

A significant part of ICNIRP's influence relies on the fact that shortly after establishing the ICNIRP, its founder Michael Repachioli moved on to work for WHO, where he created a small office that would assess and disseminate ICNIRP's guidelines to promote global standardization. This office,

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* https://www.icnirp.org/en/publications/article/rf-guidelines-2020480.html

† “Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis”, (Norwegian with English summary) https://bit.ly/3Cu9IDW, or https://www.fhi.no/globalassets/2012-3_mobilstraling

The International EMF Project, has a staff of only one manager and one secretary, and draws on ICNIRP members and others with their mindset in its work.

Formally, the WHO does not recommend the ICNIRP's or any other guidelines to its own member states, but in reality all recommendations are in line with ICNIRP's. More on ICNIRP, exposure limits, and ICNIRP's way of work through WHO and through science reviews is summed up in Part 6 of this book, which draws heavily on, and expands on our Part 3 in:

> Ref. 11: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, 590 pages (Norwegian)*

2.4 Difficult to change although change is needed

The organisation of the sector is so closed and so complex that most people drop out and leave this to public administration to handle. This applies not least to politicians, and is a democratic problem – particularly because it leaves so much room uncontrolled for the actors. The problem is all the greater since the shaping of standards is in fact left to a closed foundation – ICNIRP (with IEEE one step further back) – consisting of just a few people connected to the industry. Then national administrative bodies with very few people dedicated to the matter become quite flimsy, while the industry is big, strong and rich, and a taxpayer of great importance to the treasury in many countries.

The various laws, regulations and bodies creating and maintaining them, mutually legitimize each other: Every single law and regulation must be the way they are since the others are the way they are, and because everything is connected and is too complex to change. This is a major problem when crucial weaknesses are present in the guidelines' prerequisites and when urgent change is needed. While we must live with the consequences of failure, change comes only very slowly.

Those sections of public administration and industries having stakes in radiation protection, have together over time, built up a kind of industry understanding which is in serious conflict with health and environmental interests, but which is almost "welded" into the regulations and the organisations governing the sector.

This has become an acute problem affecting public health – because the greatly increased and increasing use of microwave radio and electronics leads to health and environmental damage. (More detailed substantiation of this claim follows in this book.)

Over time, these very same actors have created an "in-group culture" that primarily finds the solutions to societal problems in the technology they manage, while shielding themselves from knowledge about the problems created by the very same technology. Having worked for decades within the sector, we know this all too well. The phenomenon carries the label *path dependency*:

The players cannot imagine anything but themselves being right and acting rightfully, the dominant notion being that the benefits of the man-made electromagnetic fields – in the form of microwave communication, electricity, etc. – *a priori* outweighs the health and environmental risks embedded. And besides, the health risk cannot be real – "because then we would since long know about it…"

A comprehensive and detailed analysis with a lot of material we had not previously discussed has come to our attention during the completion of this book:

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* Flydal, Einar & Nordhagen, Else (ed.): 5G og vår trådløse virkelighet – høyt spill med helse og miljø, Z-forlag, 2019, https://bit.ly/3IuR5Ub, or https://einarflydal.com/?smd_process_download=1&download_id=76665

Ref. 12: Butler, Tom: Wireless Technologies and the Risk of Adverse Health Effects in Society: A Retrospective Ethical Risk Analysis of Health and Safety Guidelines, Working Paper, Univ. of Cork, 2021, PDF note, https://bit.ly/3WpO9MM*

Butler's study describes, with extensive and thorough underpinning, how the aforementioned industry understanding has developed, based on an understanding of the state of knowledge that many players should have known was incorrect, and Butler describes how this understanding of the industry fails scientifically and ethically. He describes and analyses how industry's understanding is defended – in part out of ignorance as to the research findings and scientific evidence, in part through unethical methods such as direct fraud and in part out of what the players have perceived as political needs.

We therefore refer to (Butler 2021) as a very valuable addition to this book, without us having had the opportunity to give this article the space it deserves deserves.

2.5 The research on health effects and the controversy around them

Here, the state of research on health effects from "non-ionizing radiation" and the contradictions between the research findings and the sector regulation are discussed. The topic is elaborated in later parts.

There is an extensive specialist literature as well as more popular scientific literature presentations dealing with harmful and therapeutic effects of electric and electromagnetic fields. Arthur Firstenberg's comprehensive and popular science book shows that ever since the first experiments in the 18th century, scientists have observed biological effects from weak currents, and also that some people are significantly more susceptible to such exposure than others.

Ref. 13: Arthur Firstenberg, The Invisible Rainbow – A History of Electricity and Life, AGB Press, 2017

A very large majority of the published research studies registered in the databases (such as PubMed, ORSAA, Medline, Powerwatch.org, EMF-Portal), shows harmful health effects from exposure levels against which no protection is given by the precautions and regulations that are applicable in, among other countries, Norway.

For example, the literature database of ORSAA (Oceania Radiofrequency Scientific Advisory Association Inc.), a not-for-profit research organisation that researches the effects of artificial electromagnetic fields on humans and the environment, finds a large majority of studies that demonstrate effects that can lead to health damage/disorders (Figure 5).

Ref. 14: ORSAA – ICNIRP submissions Oct 1918, ORSAA, https://www.orsaa.org/icnirp-submission.html

Of 3,226 references to peer-reviewed research articles, 2,013 of the references show findings of such effects when exposed below the thermal limit.

Henry Lai was the scientist in the USA who first demonstrated damage to DNA from the microwave radiation experimentally.

Ref. 15: Lai, H; Singh, N. P. (1995). "Acute low-intensity microwave exposure increases DNA single-strand breaks in rat braincells" (PDF). Bioelectromagnetics. 16 (3): 207–10. ISSN 0197-8462. PMID 7677797

* or https://einarflydal.com/wp-content/uploads/2021/02/Butler-Tom-Wireless-Technologies-Ethical-Risk-Analysis-Working-Paper-Univ.-Cork-2021.pdf

See Figure 6: Light bars: no effect found. Dark bars: effect found. The pillars shows from left: Gene damage from wireless (76 studies), Gene damage from low-frequency fields (46), Oxidant damage from wireless (200), Oxidant damage from low-frequency fields (186), Neurological effects from wireless (325). In December 2017, Lai sorted research articles in the Medline database showing findings vs. no findings of harmful effects, for the period 1990-2017.

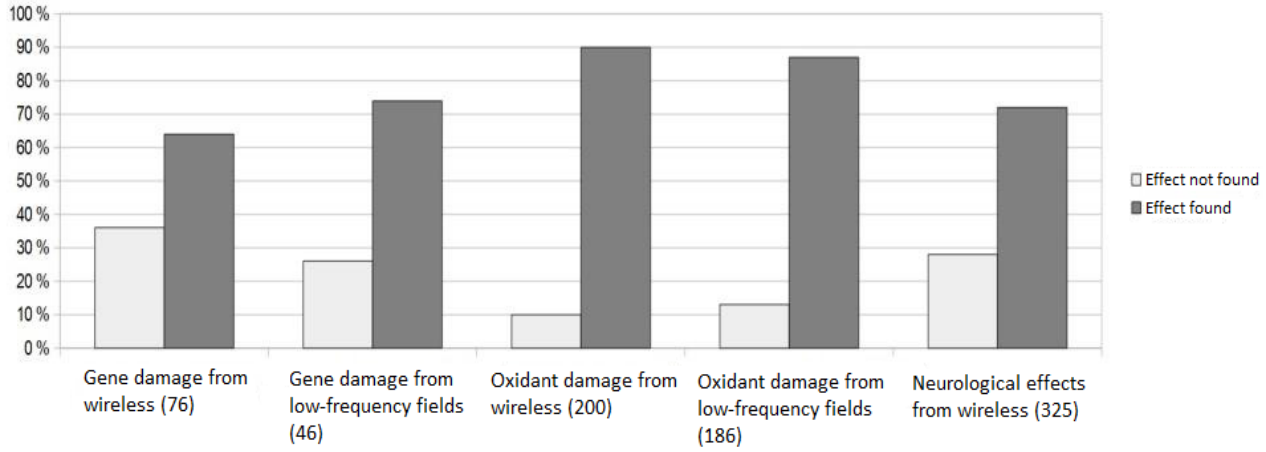

Figure 6: Research articles on radiation and health in Medline 1990 – 2017 split on kinds of damage, effects found vs. effects not found (Lai 2017, graph: E. Flydal)

The research clearly shows a predominance of injuries, regardless of mechanism. An update up to 2020 has subsequently been performed by Lai, showing the same pattern. (Not included here.)

> Ref. 16: Henry Lai's Research Summaries, nine documents posted on http://www.bioinitiative.org/research-summaries/, December 2017

The Powerwatch database contains a selection of references, and therefore does not reflect the overall research. In this database, the studies are labelled based on whether they find or do not find biological effects. A large number of studies show harmful effects below the current exposure limits:

> Ref. 17: Powerwatch, http://www.powerwatch.org.uk/

Joel M. Moskowitz, Ph.D., director of the Center for Family and Community Health, School of Public Health, University of California, Berkeley, has reviewed the Powerwatch database and published an overview and bibliography based on it. The summary shows 61% of the references report finding effects below the exposure limits (based on protection against overheating):

> Ref. 18: Joel M. Moskowitz, Joel: PowerWatch: 1,670 Scientific Papers on Electromagnetic Fields, May 1, 2019, http://bit.ly/PowerWatch1670

The EMF-Portal RWTH at the University of Aachen summarises systematic scientific research data on effects from electromagnetic field (EMF). All information is available both in English and German. The core of EMF-Portal is a literature database with an overview of 32,641 publications and 6,831 summaries of scientific studies on effects of electromagnetic fields.

This database does not provide summarised overviews of findings. Nevertheless, it is clear that it contains a large number of studies that show harmful effects below the current exposure limits.

> Ref. 19: EMF-Portal, https://www.emf-portal.org/

The guidelines for calculating recommendable exposure limits for exposure to radio frequency radiation issued by the private, non-transparent foundation ICNIRP, forms the basis for exposure limits throughout the Nordic region. They are based only on acute overheating or nerve stimulation as the harmful effects on tissues to be used as damage criterion. These guidelines do simply not aim to protect against the non-thermal biological effects that most research studies find – as ICNIRP claims it is not proven they are related to EMF exposure and therefore should not be taken into account.

> Ref. 20: ICNIRP, 1998. "ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic And Electromagnetic Fields (UP To 300 GHz)", Health Physics 74 (4):494-522; 1998, https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
>
> "Induction of cancer from long-term EMF exposure was not considered to be established, and so these guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns caused by touching conducting objects, and elevated tissue temperatures resulting from absorption of energy during exposure to EMF."

Quite contrary to the pattern of findings in the databases indicated above – ICNIRP states that the rationale for using tissue heating as injury criterion, is that...

> Ref. 21: ICNIRP, 2020. Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), published ahead of print in: Health Phys, March 2020, https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf
>
> "There is no evidence of adverse health effects at exposure levels below the restriction levels in the ICNIRP (1998) guidelines and no evidence of an interaction mechanism that would predict that adverse health effects could occur due to radiofrequency EMF exposure below those restriction levels."

Literature reviews summarizing the research in this area, confirm that there has long been an extensive professional discussion on health effects from EMF, with thousands of published research studies. Here a couple of examples are mentioned:

A Russian research review commissioned by the Soviet Union's Science and Technology Academy of Sciences, was published in English (Presman 1970) at the initiative of American scientists. It contains 678 references – including Russian, German, Polish and American, and discusses a wide range of biological mechanisms of fundamental importance for all life, acting at very weak (non-thermal) intensities. Presman takes the findings to mean that it is not the *intensity* that is important, but the *information value* carried in the signal, and that the information value is retained even at extremely low intensities.

Biology can therefore easily be disrupted, with biological damage as possible results:

> Ref. 22: Presman, A. S., 1970. "Electromagnetic Fields and Life", English edition: Springer science+business media LLC, New York, 1970, ISBN 978-1-4757-0637-6, https://bit.ly/3vJIRA8*
>
> Pages 4 and 5: "Thus, physicists concluded that weak EmFs were incapable of producing biological effects [other than as reactions caused by tissue heating].
>
> "In spite of these categorical conclusions biologists continued with experimental attempts to detect biological effects due to EmFs and constant magnetic fields with strengths much

* or https://www.scribd.com/document/57754705/Presman-Electromagnetic-Fields-and-Life-1970

> lower than the theoretical predicted effective values. Within the last ten years [i.e. before 1970] these attempts have produced successful results, which give grounds for believing that natural EmFs have probably been implicated in the evolution of life and play a significant role in the vital activity of organisms. One cannot help recalling in this connection the words of Szent-Gyorgyi (1960) [Nobel Prize winner in physiology] that: "the biologist depends on the judgement of the physicist, but must be rather cautious when told that this or that is improbable".
>
> "Biological investigations have shown that organisms of the most diverse kinds – from unicellular organisms to man – are sensitive to a constant magnetic field and EmFs of different frequencies, with an effective energy tens of orders (!) less than the theoretical estimated effective level [needed for tissue heating]."

As an example, reference can also be made to basic medicine physician and geneticist Martin L Pall's review of almost 200 research studies, each of which reviews several research papers that find medical effects of (sub-thermal) EMF exposure in various areas. In total, an enormous amount of research material is therefore reviewed, and all conclude that the findings are well documented.

> Ref. 23: Pall, Martin L: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, note dated 17.5.2018, https://bit.ly/3YLV3gX*

Pall's review is reprinted (in Norwegian) and commented on as follows:

> Ref. 24: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019 (Norwegian), page 178:†
>
> "Based on more than 180 literature reviews, Martin L Pall wrote the following large paper of 90 A4 pages. Admittedly, huge parts of the paper are literature references and quotes from the reviews' abstracts. With this paper he intended to – once and for all – document how pointlessly wrong the European Commission was in its claim that health damage from microwave communication has not been proven, and that such damages would be incompatible with the present research.
>
> …
>
> What Pall does in his paper, is to make a literature review of literature reviews: He examines other people's literature studies, close to two hundred of them, and examines what secure evidence they find demonstrated in the primary studies. In other words, the conclusions are based on a very large amount of scientific material.
>
> This is how Pall finds strong proofs – in empirical sciences more correctly termed evidence – by demonstrating that the similar connections have been found in multiple literature studies and discussed and found to be tenable. Hence, they stand firmly as proofs, and it is outright fraud or irresponsible to pretend they don't exist or to ignore them."

However, this discussion is still ongoing. From the one camp, the professional discussion is maintained by a constant flow of new research finding harmful effects. These findings maintain and increase the understanding of living organisms as complex and susceptible to electrical systems. From the other camp, these findings are discarded as not sufficiently certain ("established" or "substantiated"), while research finding no effects is highlighted as evidence of either there being

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* or https://einarflydal.com/wp-content/uploads/2018/10/Pall-ML-5g-emf-hazards-eu-emf2018-6-11us3.pdf

† For full reference; see Ref. 11 on page 24.

still unresolved issues that should be clarified before conclusions can be drawn and restrictions imposed, or that there be no harmful effects at all.

In the above mentioned paper, Pall shows that such “discoveries” of “nothing found” are produced and exploited as part of “war gaming” – a strategy game driven by industries that work to maintain high exposure limits, securing a correspondingly large room for action.

Cell physiologist Susan Pockett provides extensive scientific evidence for harmful effects and underlying mechanisms, and explains the debacle as resulting from the “military-industrial complex”, today involving the telecoms industry as a significant player. This complex has gained too much power in society, and sees itself served in various ways by weakening the impression that science’s findings are certain and clear:

> Ref. 25: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW, see especially Chapters 2, 3 and 4.*

The purely academic aspects of the controversy may also be explained as rooted in the built in resistance from radiation hygienist physics: This scientific tradition dominated by physicists sees it as natural and reasonable to establish methodological requirements that cannot reasonably be met in biological research, thereby discarding all findings, even the most obvious ones, as not well enough proven, i.e. what in scientific methodology is labelled “a type 1 error”:

> Ref. 26: Else Nordhagen and Einar Flydal: The Norwegian Radiation Protection Authority claims the radiation does not harm. Why?, (Norwegian) blogpost 04.02.2021†

Part of the controversy is also a fight to seize control over institutions with strong *power of definition*, i.e. the power to define how society shall perceive certain topics. It is documented in a range of studies that industries linked to the utilization of EMF (defence, radar and the radio industry, the power industry and mobile communications) have used similar strategies such as the tobacco industry and several other industries to promote theirs interests, not least by creating doubt about research results.

> Ref. 27: Conway, Erik M. and Oreskes, Naomi: Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, Bloomsbury Press, 2010
>
> Page 5: “A few years later, Santer was reading the morning paper and came across an article that described how certain researchers had participated in a research program that was organized by the tobacco industry to discredit scientific evidence linking tobacco to cancer. The purpose, the article explained, was to “keep the disagreement alive”. So as long as there was doubt about the causal relationship, the tobacco industry would be safe from lawsuits and regulations. Santer thought the story seemed frighteningly familiar.”

Santer, who is mentioned in Orestes & Conway above, was an atmospheric scientist at Lawrence Livermore Laboratory and fought to get through that climate change was occurring and that this was linked to a man-made increase in greenhouse gases. He faced a lot of familiar types of resistance before this understanding became “mainstream”.

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* https://www.safertechnology.co.nz/wp-content/uploads/2021/04/ELECTROSMOG-May-2021.pdf We relate to the Norwegian edition: Susan Pockett: Stråletåka – Helse- og miljøforurensningen fra mikrobølgene, 237 pages, Z-forlag, 2020, ISBN 978-82-93187-50-9. This book in Norwegian is a translation slightly revised in cooperation with the author. We have not checked the English PDF, issued in 2021.

† “Strålevernet hevder at strålingen ikke skader. Hvorfor?”, https://bit.ly/3BX19B5, or https://einarflydal.com/wp-content/uploads/2021/02/E-Nordhagen-og-E-Flydal-Stralevernet-hevder-at-stralingen-ikke-skader-Kronikk-v1.2.pdf

The strategy mentioned here is to create uncertainty about the research results by producing or highlighting research that does not find harm. This strategy is also mentioned in Michaels' well-known descriptions of several industries' strategies in the book and movie “Doubt is their product”:

> Ref. 28: Michaels, David, Doubt is their product, Oxford University Press, 2008, ISBN 0199719764, see e.g. ch. 14: The Institutionalization of Uncertainty, p. 176 etc.

How this strategy is carried out within the wireless industry has been analysed in a number of studies, e.g. in the following, first in general:

> Ref. 29: Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y., 2017
>
> Page xvii, Introduction: “Stories of data manipulation on the emissions from cars, which affected Volkswagen and other car producers, have recently been reported in the mainstream media. It could be said the manipulation of “scientific” evidence by corporations has now come of age – a real and recognisable factor in the litany of corporate malfeasance.
> …
> “The chapters that follow in this book demonstrate clearly that data and science “bending” have a long history, which, because such incidents have apparently still been in the area of “doubt”, have rarely been given space in the public media. This book scrutinizes this history, especially since the 1970s, in many different areas of corporate propaganda and the attempts to cover up public health risks.”

and then more directly on the mobile phone industry:

> Ref. 30: Wright, Nicola: “Downplaying Radiation Risk”, Chapter 23 in Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y., 2017
>
> From page 421: “In this chapter we are going to look at how the telecommunications industry has taken control of the institutions that set exposure guidelines, those that research the health effects of exposure to microwaves, and those that disseminate information to the public.”

Central to these analyses are descriptions of how the industry has taken control over forums which should basically play the role of neutral professional bodies for investigations and consensus decisions, such as standardization bodies and public administration.

Thus (Alster 2015) describes how the US regulatory authority is dominated by the interests of the wireless industry:

> Ref. 31: Alster, Norm: Captured Agency, How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates, Edmond J. Safra Center for Ethics, Harvard University, 2015, https://bit.ly/3Co7NR6*
>
> Page 5: “But direct lobbying by industry is just one of many worms in a rotting apple. The FCC sits at the core of a network that has allowed powerful moneyed interests with limitless access a variety of ways to shape its policies, often at the expense of fundamental public interests. As a result, consumer safety, health, and privacy, along with consumer wallets, have all been overlooked, sacrificed, or raided due to unchecked industry influence. … Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC’s Congressional oversight committees to its persistent agency lobbying. … On a personal level, the entire

* or https://ethics.harvard.edu/files/center-for-ethics/files/capturedagency_alster.pdf

> system is greased by the free flow of executive leadership between the FCC and the industries it presumably oversees."

Others have described how the standardization bodies within the IEEE, USA's engineering association, with its numerous standardisation committees once well balanced, has gradually become dominated by the industry's engineers, who create and adopt technical standards that they then implement themselves in the companies in which they are employed, e.g:

> Ref. 32: Stein, Brian & Mantle, Jonathan: The Microwave Delusion, Grosvenor House Publishing, 2020.

> Ref. 33: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, see especially Part 3. For full ref, see Ref. 11.

During the first period after the Second World War, attention was particularly directed towards health risks and acute injuries among military and civilian personnel connected to military facilities, transmitters and radars. The acute symptoms were often regarded as trivial, and under-reported as "subjective":

> Ref. 34: Paul Brodeur: The Zapping of America, N.Y. 1977, ISBN: 978-0393064278

> Page 24: "By the spring of 1942, faced with a crescendo of rumours and inquiries about radar, the Navy undertook a medical study of forty-five civilians who had been working with experimental radar at the Naval Research Laboratory in Washington, D.C. This study, which included regular physical examinations and blood tests, found no signs of sterility, unusual baldness, or any other negative biological phenomena in these men. Indeed, the only thing to turn up was that some of them complained of headaches, eye pain, and a flushed feeling in the face whenever they were exposed to microwaves emanating from radar antennas. Such symptoms were considered interesting but subjective, and when the results from the study were published in the *U.S. Naval Medical Bulletin* for July 1943, the conclusion was drawn that there was "no clinical evidence of harm to these personnel."

During this period, acute health-related reactions became known as "radar man's disease" and "radio man's disease". Such reactions were reported in several American reports that reviewed *biological effects* of non-ionizing radiation, such as this from 1975:

> Ref. 35: Adams, Ronald L, Williams, R.A.: Biological Effects of Electromagnetic Radiation (Radiowaves and Microwaves) Eurasian Communist countries (U), US Defense Intelligence Agency, 1975, https://bit.ly/3ZeeY8h*

> Page 17: "Clinical studies were done on thirty subjects aged 25 to 40 years, [who had been] exposed to industrial ultrahigh frequency centimeter waves at power densities [strength] from 10 to 500 mW/cm^2, for periods of time ranging from 4 to 13 years. Subjective complaints included generalized weakness, afternoon and evening apathy, fatigue, headache, sleep disorders, and non-radiating precordial [chest area] pain suggestive of asthenia [weakness] or neurasthenia [syndrome related to the environment/ME] with autonomic dystonia [uncontrolled muscle contractions]. ..."

In the 1980s and 1990s, the controversy was particularly directed at high-voltage power lines and household electricity. A number of disputes ended up in court. Andrew Marino had then for several years found effects on laboratory animals from even far weaker exposure, and was central to legal proceedings brought against the power industry in the USA to gain approval for safety distances for power lines:

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* or http://media.wix.com/ugd/86579e_cd32f0b5b17c4ecf84dc722f1f1a18e5.pdf

> Ref. 36: Marino, Andrew: Going somewhere – Truth about a life in science, Cassandra Publishing, 2010
>
> Page 15: “I finally reached the point where I decided — another motivation — that I had a responsibility to show how our legal system often prevents reliable science from entering the mainstream of society. To tell this story you have to be a working scientist, a lawyer, and a person who is free to do what he thinks best. I met those criteria, and I don’t know of anybody else who has, so I felt qualified and responsible.”
>
> Page 279: “… Harris concluded his remarks by emphasizing the difference between research and law. “The purpose of science is to discover the truth about nature. The purpose of the legal system is to resolve disputes, so there must be winner and a loser.”
>
> Page 390: “He told Olden that the question put by Congress could not be answered on the basis of scientific principles alone, and that the moral force of science, and the respect and confidence that people have in it should not be weakened by asserting scientific certitude where none existed.”

The lawsuits led to the US introducing rules for the construction of power lines and the utilisation of land under power lines, that took into account that the electromagnetic fields around power lines may cause cancer:

> Ref. 37: Marino, Andrew, Ray, Joel: The Electrical wilderness, San Francisco Press, 1986

In Norway, an Official Norwegian Report (NOU) was drawn up on the subject. In essence, it concluded that there was no reliable scientific evidence for any connection with cancer or other disorders, but that certain prudent precautionary measures relating to high-voltage power lines and proximity to homes, schools etc. would none the less be appropriate. See more reviews on the page.

> Ref. 38: Electromagnetic fields and health, Proposal for a management strategy, NOU 1995:20, a Report from a cross-ministerial official group submitted to the Ministry of Social Affairs and Health, Norway, 1995*

With the generalization of digital TV, digital radio, mobile phones and mobile networks, WiFi networks and other applications of microwaves taken place during the recent decades, the focus of both scientific investigations and struggles for power has shifted from the health effects of household electricity to the effects of microwaves.

As a corollary, there has been a tremendous growth of exposure levels of microwaves for the general public. From a background radiation close to zero to a frequently occurring background radiation in cities of around 10^{18} times more powerful, i.e. an energy intensity in the order of 1,000,000,000,000,000,000 times higher.

> Ref. 39: Bandara, P., and Carpenter, D. O. 2018. “Planetary electromagnetic pollution: it is time to assess its impact”, The Lancet, vol.2:12, e512-e514, https://bit.ly/2LnZXLV †
>
> “Due to the exponential increase in the use of wireless personal communication devices (eg, mobile or cordless phones and WiFi or Bluetooth-enabled devices) and the infrastructure facilitating them, levels of exposure to radiofrequency electromagnetic radiation around the

* NOU 1995:20 Elektromagnetiske felt og helse — Forslag til en forvaltningsstrategi, Statens forvaltningstjeneste, 1995, https://www.regjeringen.no/no/dokumenter/nou-1995-20/id140410/

† or https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(18)30221-3/fulltext

1 GHz frequency band, which is mostly used for modern wireless communications, have increased from extremely low natural levels by about 10^{18} times (figure)".

With this growth, exposures in cities has come significantly closer to the thermal limit, which since 1998 has been the relevant threshold for the ICNIRP recommendations for working life and for the general public (see Figure 7).

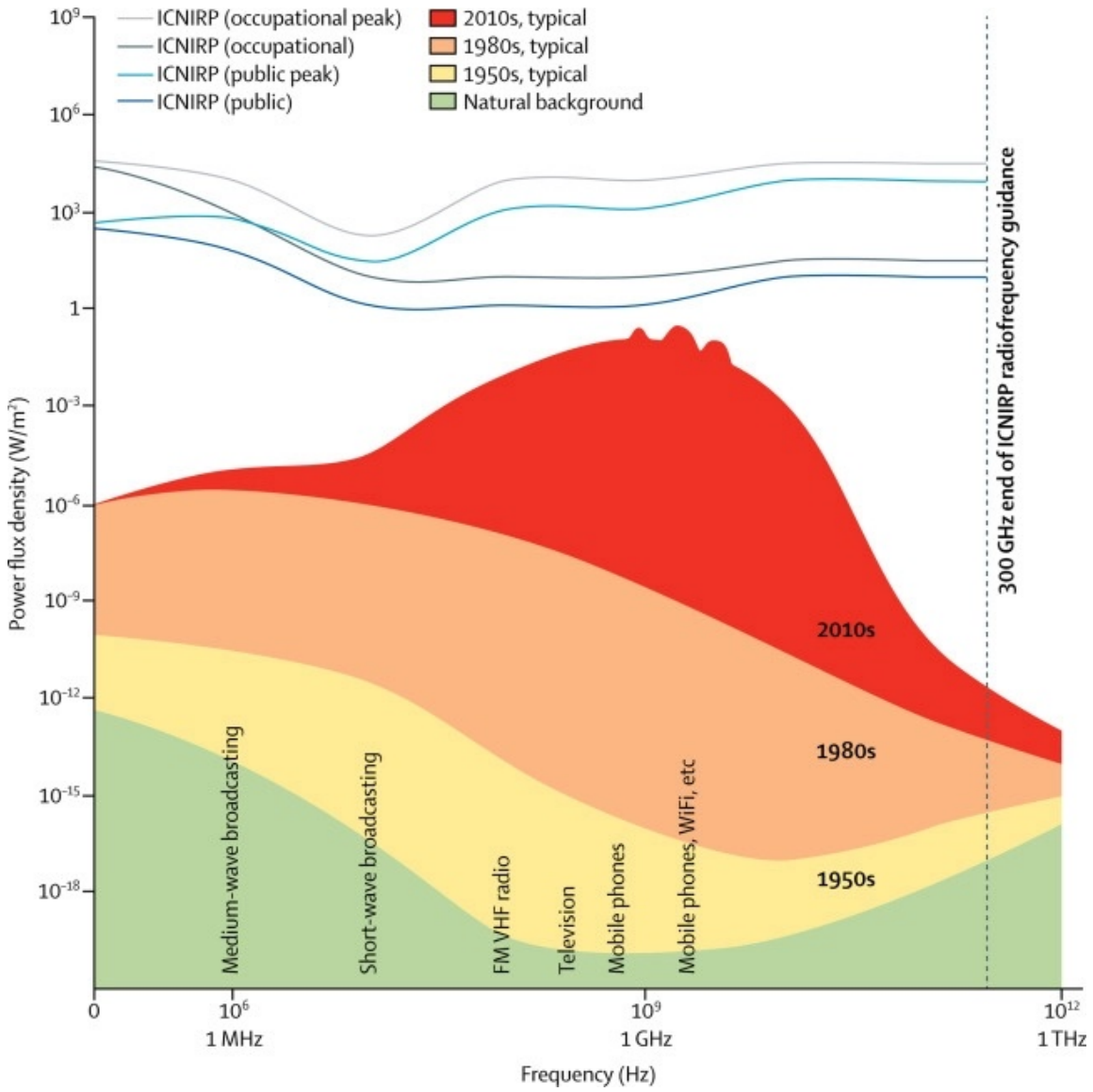

Figure 7: Typical maximum daily exposure compared with ICNIRP's guidelines (from Bandara & Carpenter 2018)

The current ICNIRP guidelines for exposure limits specify that they are only intended to provide protection against thermal tissue damage, and that they leave to later stages in what we could label "the exposure regulation supply chain", i.e. to regions (such as the EU) and to national authorities (such as the national Radiation Protection Agencies) to assess whether more restrictive limits are needed to protect against other possible effects and to set the recommended exposure maxima.

The Norwegian authorities do nevertheless claim that exposures below these thermally based exposure limits "do not pose any health hazard". This is repeated in writing and in speech as well as in TV interviews, and it is repeated in the brochures referenced below, which also neglect the effects

of *near fields*, the electromagnetic fields close to the source, where special physical properties make exposures far more intense. The energy intensities in near fields cannot be measured with any certainty, neither can they be measured with methods for measuring the energy intensities of *distant fields.* (We shall return to examples of near fields.)

> Ref. 40: Two brochures from the Norwegian RPA (DSA) on “non-ionizing” radiation protection, May 2020, https://bit.ly/3CrKdDg*

The main message of these two brochures is that radiation below the exposure limits is safe and not at all hazardous to health. The brochures give the impression that scientific research clearly shows that in practice there are no health hazards and that the respective agencies (Norway: DSA, NKOM and The Norwegian Labour Inspection Authority) take care to protect people's health against damage from such:

> From page 4: “A mobile phone held to the ear provides the highest levels, relatively speaking, but the levels are still below the limit value, hence, it is safe to use mobile phones.”
>
> From page 5: “There is no scientific basis for recommending the removal or replacing of wireless networks with wired networks.”

Such allegations about the lack of health hazards lack scientific underpinning in the documents on which the Norwegian Radiation Protection Authority (DSA) reports to rely upon. DSA states that these are the Radiation Protection Act and the Radiation Protection Regulations, the ICNIRP's guidelines, WHO's assessments – which are consistent with ICNIRP's, a science review carried out by an ad hoc committee (FHI report 2012:3), which conform to ICNIRP's thermal dogma, and the assessments from a scientific committee under the Swedish Radiation Protection Authority's (SSM). All these for a consist mainly of ICNIRP members. They therefore have views consistent with ICNIRP's.

In fact, it has been documented in a number of sources that ICNIRP's members and close associates recur in key positions in all these bodies, which may explain why their conclusions coincide, while at the same time being strongly different from the vast majority of research results.

For more details see e.g. Part 3 in

> Ref. 41: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, see especially Part 3. For full ref, see Ref. 11.

As we have referred to in (Nordhagen and Flydal 2021, Ref. 26), and repeat several times in this book, these bodies base their views on scientific methods and quality assessments not adapted to the complexity of biological systems. They frequently safeguard themselves by stating – correctly – that “harm has not been proven” (i.e., not proven based on the methodological requirements they request), not that the harm “does not occur”, nor that it may be caused from such radiation. Nor do they say that radiation from transmitters “is not dangerous” or that it “is safe”. They are too careful for such statements. The Norwegian radiation protection authority, however, is less nuanced, claiming there are no such health risks. Such claims are in conflict with what is permissible statements within HSE for the description of physical/chemical properties of a product or an agent.

This point is underscored by HSE consultant Bård-Rune Martinsen:

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* https://dsa.no/nyheter/oppdaterte-brosjyrer-om-elektromagnetisk-straling, or https://einarflydal.com/wp-content/uploads/2020/07/DSA-NKOM-Arb.tilsynet-To-brosjyrer-om-stråling-2020-rev.-juni-1.pdf

Ref. 42: Bård-Rune Martinsen “The Norwegian Radiation Protection Authority is active in directly illegal and misleading marketing”†, 2019

From this reference, page 443 onwards, we cite extensively:

> “When DSA has taken the extreme position that the radiation is not dangerous to health, it is natural to request from DSA to present the evidence. DSA cannot provide any such evidence:
>
> [The Norwegian RPA is] obviously also in conflict with the scientific majority, as shown above. ... Lars Klæboe [senior adviser] with DSA [the Norwegian RPA] uttered in the [news broadcast] *Dagsrevyen* on the 28. of May 2019: “Strictly speaking, this is about watts and frequencies, something we have had around for 70-80 years.” … “It is inconceivable that this could cause serious harm to health.”
>
> One might feel comforted by knowing that this RPA’s views are based on the view that such effects are 'unthinkable' and that man-made radiation “has been around” for 70-80 years. However, such statements do not constitute any scientific basis on which to build conclusions.
>
> **Outside the norms**
>
> Are there norms as to how to describe the physical/chemical characteristics of an agent? Yes, there are. In the sale and distribution of drugs and mixtures, it is required to adhere to established classification. Commission Regulation 2015/830, which is incorporated into the Norwegian “REACH regulations”, point 0.2.4, states:
>
> > “Expressions such as “may be dangerous”, “no health effects”, “safe under most conditions of use” or “harmless”, or any other expressions indicating that the substance or the mixture of substances is not dangerous, or any other expression that is not compatible with the classification of the substance or mixture of substances, shall not be used”.
>
> In other words, it is not even allowed to classify or label sterile water as harmless.
>
> Radiation is probably not a substance, but still an agent, so one should expect the same care and sobriety to be shown in the description of that agent, so that users are not led to believe something that has not been proven. It is quite remarkable and odd that the RPA will so easily classify radiation as harmless, and thus not hazardous to health.
>
> Regulations also protect Norwegian consumers against medical products to be marked with “not dangerous”. Labelling a medicine with “not hazardous to health” may, according to the Norwegian Medicines Agency, be considered being nothing but marketing. In other words, this is the activity in which the Norwegian Radiation Protection Agency engages.
>
> **Misleading marketing**
>
> It is well known that “alternative medicine” and its promises of efficacy is being cracked down on. It is simply not permitted to advertise that the drug or treatment has any effect if the effect cannot be proven. The Norwegian RPA DSA has itself reported practitioners of alternative medicine on this basis (The Quack Act).

† “Norsk strålevern driver direkte ulovlig og villedende markedsføring”, pages 436- 446 in Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment. For full ref, see Ref. 11.

> However, DSA has gone all out and markets that radiation from mobile phones, WiFi and AMS (smart meters) is harmless. On DSA's Facebook pages you can find questions and answers about radiation. Among those Questions and Answers we find the following: “Do I have to connect the wireless network to a cable? No, there’s no need for a cable – it will just be a waste of money.” This is active marketing for wireless technology at the product level. Wireless products are marketed as not hazardous to health. The DSA thereby provides a guarantee to buyers of such goods that those products are not hazardous to health. This guarantee is reinforced when DSA advises against not using wired technology.
>
> This is most likely a violation of Section 3 of the Marketing Act. Claims of “fact”... “must be able to be documented”. DSA presents “harmless” as a factual relationship, but cannot document this. It also seems to be a breach of Section 6 of the Marketing Act, since DSA's communication “is likely to significantly change consumers' economic behaviour so that they make decisions they would not otherwise have made”. To dissuade one technology in favour of another is likely to significantly change consumer behaviour.
>
> In addition, the rollout of AMS meters also falls under section 6: Installation of microwave communicating AMS (Automatic Metering System) has been considered an order from a public authority [NVE], and that public authority has been able to implement the rollout unimpeded due to the AMS meters’ communication being labelled as “harmless” by the DSA. If radiation hadn't been labelled as “harmless”, other government agencies and network companies would possibly investigate the possibilities for wired AMS solutions more thoroughly and possibly offered such, or insisted that they would only consider themselves obliged to replace the meters if such could be used instead.”

In a feature article in Norway's “Financial Times” equivalent [*Dagens Næringsliv*], 16 January 2021, Gunhild Oftedal, member of the ICNIRP and an expert used by the WHO's office *The International EMF Project*, is quoted as saying “it has not been proven that radiation from wireless technology … is dangerous”. At the same time, she claims that the effects that are actually observed at non-thermal intensities have not been proven harmful. Within which framework ICNIRP and Oftedal make their assessments, whether the assessment criteria are reasonable, and how non-proven suspicions shall be handled is not discussed:

> Ref. 43: “Lawyer firm top Hugo Matre sent a letter critical as to radiation – without saying who the clients were”, *Dagens Næringsliv*, 16 January 2021, https://bit.ly/3vnafDD*
>
> “Associate Professor Gunnhild Oftedal at NTNU emphasises that it has not been proven that radiation from wireless technology such as mobile phones, base stations, routers and power meters, is dangerous. She refers to the latest recommendations presented in March [i.e. the ICNIRP 2020 guidelines]:
>
> - The report from ICNIRP (International Commission on Non-Ionizing Radiation Protection) concluded that health damage only exists if the radiation is so strong that it causes harmful heating, says Oftedal. She adds that some studies show that even weak exposure can produce biological effects.
>
> - But ICNIRP considers that there is no proof that such effects lead to disease.”

As we have seen above, such assessments as “there is no evidence that such effects lead to disease” is in obvious discrepancy with the scientific majority and the view that, fundamentally, all impacts

* “Schjødt-topp Hugo Matre sendte strålingskritisk brev – uten å si hvem klientene var”, https://www.dn.no/jus/tradlos-teknologi/straling/advokatfirmaetschjodt/schjodt-topp-hugo-matre-sent-radiation-critical-letter-without-saying-who-the-clients-was/2-1-882397

have the potential for harm. Such assessments rest on, and are justified on the basis of the extremely small network that is behind the papers used by the ICNIRP to underpin its new exposure limits of March 2020.

The tight and small network behind today's recommended exposure limits has been analysed and criticised in a number of professional articles and in the reports of investigative journalists, as well as in various other reports.

A few sources are mentioned here:

> Ref. 44: Buchner, K. and Rivasi, M. (2020) The International Commission on Non-Ionizing Radiation Protection: Conflicts of interest, corporate capture and the push for 5G. A Report by Members of the European Parliament, Michèle Rivasi (Europe Écologie) and Dr. Klaus Buchner (Ökologisch-Demokratische Partei), June, 2020, 1-98. https://bit.ly/3ZeonNf *
>
> Ref. 45: Impacts of 5G wireless communications on human health, Briefing to the European Parliament on 5G from the European Parliamentary Research Service, PE 646.172 NO February 2020, https://bit.ly/3CtWLKt †
>
> Ref. 46: "How much is safe?", Investigate Europe, 4 January 2019, https://www.investigate-europe.eu/en/2019/how-much-is-safe/
>
> Ref. 47: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, see especially Part 3. (For full ref, see Ref. 11.)
>
> Ref. 47b: Added 2023 - Nordhagen EK, Flydal E. Self-referencing authorships behind the ICNIRP 2020 radiation protection guidelines. Rev Environ Health. 2022 Jun 27. doi: 10.1515/reveh-2022-0037. Epub ahead of print. PMID: 35751553, https://bit.ly/3CvHOY9 ‡

As shown above, the exposure limits recommended by Norwegian authorities in this area are based on a criterion – the heating criterion, or thermal dogma – which is under strong criticism for not being sufficient for radiation protection of public health, and "marketed" by a process which is unclear and illegitimate.

We shall return to the criteria and delivery processes in greater detail towards the end of the book. The criteria, processes and selections of evaluated scientific works do not ensure the necessary quality in the assessments, neither at the beginning, nor in the middle or towards the end of the regulatory supply chain.

2.6 Mechanisms causing biological damage – without heating

A wide range of mechanisms that can cause biological damage, have been identified. Dirty electricity and pulsation are central in this context. Dirty electricity and pulsing is further treated in later parts.

Adverse effects from exposures weaker than the thermal threshold have been demonstrated in many studies and by many different methods – including epidemiological (statistical population studies), laboratory experiments, theoretical calculations and clinical studies.

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* https://kompetenzinitiative.com/wp-content/uploads/2020/07/ICNIRP-report-FINAL-19-JUNE-2020.pdf

† Or https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS_BRI(2020)646172_EN.pdf

‡ https://www.degruyter.com/document/doi/10.1515/reveh-2022-0037/html

Scientific research has demonstrated a number of different mechanisms. In (Horsevad 2017), more than 100 proven biophysical mechanisms activated from exposures weaker than the thermal limit, are reviewed:

> Ref. 48: Horsevad, Kim, Kortlægging, Mapping Bioreactivity for Microwaves in Non-thermal Intensities, Saxo Publishing, 2017, ISBN 9788740912418

Theoretically, it is reasonable to imagine that such a multitude of mechanisms may exist, since electricity is a fundamental property of all chemistry and that therefore any chemical process could conceivably be disrupted by external influences (interference). The existence of such mechanisms by which electromagnetism affects biochemical processes demonstrates that there is a potential for damage.

It has been demonstrated to be a common feature that electrical pulses – i.e. abrupt shifts in the electromagnetic field – have far greater biological impact than exposure without pulses or with weaker, less abrupt shifts. Such effects are detected even with very weak exposures when pulses occur:

> Ref. 49: Panagopoulos, Dimitris, 2019. “Comparing DNA Damage Induced by Mobile Telephony and Other Types of Man-Made Electromagnetic Fields”, Mutation Research/Reviews in Mutation Research. 781. 10.1016/j.mrrev.2019.03.003
>
> “The present review – of results published by my [scientific research] group from 2006 until 2016 – compares DNA fragmentation induced by six different EMFs on the same biological system – the oogenesis [the formation and maturation of egg cells] of Drosophilia melanogaster [the fruit fly] – under identical conditions and procedures. Such a direct comparison between different EMFs on the same biological system – especially those employed in daily life – on the same biological endpoint, is very useful for drawing conclusions on their bioactivity, and novel. It shows that real MT [Mobile Telephony] EMFs are far more damaging than 50 Hz alternating magnetic field (MF) – similar or much stronger to those of power lines – or a pulsed electric field (PEF) found before to increase fertility. The MT EMFs were significantly more bioactive even for much shorter exposure durations than the other EMFs. Likewise, they were more damaging than previously tested cytotoxic agents like certain chemicals, starvation, dehydration. Individual parameters of the real MT EMFs like intensity, frequency, exposure duration, polarization, pulsing, modulation, are discussed in terms of their role in bioactivity. The crucial parameter for the intense bioactivity seems to be the extreme variability of the polarised MT signals, mainly due to the large unpredictable intensity changes.”

In the electrical trades, such sudden pulses are often referred to as *voltage noise* and *transients*, and popularly called “dirty electricity”. This is primarily perceived by electro-engineering professionals as a technical problem related to *electromagnetic noise* that can interfere with, and damage, technical appliances.

In the field of radiation protection and scientific research on health effects, dirty electricity is gradually emerging on the agenda as a major health problem and has been the subject of health studies. In the West, this only really happened after the turn of the millennium, with the findings at the La Quinta School, California: An accumulation of cancer was found among teachers who taught in certain classrooms. There, it turned out, the levels of dirty electricity were particularly high, coming from an electrical substation close to just these rooms. It turned out that even the students' unusually strong restlessness in these classrooms could be “switched ON and OFF” by the inadvertent uses of filters removing dirty electricity.

Ref. 50: Milham, Samuel: Dirty Electricity – Electrification and the Diseases of Civilization, iUniverse, 2012, ISBN 978-1938908187, pp. 55 ff.

For a fuller account of the La Quinta School case, see:

Ref. 51: Samuel Milham and L. Lloyd Morgan: A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School, https://www.stetzerelectric.com/wp-content/uploads/Milham-Morgan-2008.pdf

There is now a considerable literature on health problems linked to dirty electricity. For an overview that partially overlaps with the references in this book, see:

Ref. 52: Literature list on dirty electricity (Norwegian and non-Norwegian literature), https://bit.ly/3VKGU0M*

2.7 Pulsing and dirty electricity – same thing, different attention

In this section it is pointed out that pulsation and dirty electricity are largely the same phenomenon, but that dirty electricity has received little attention.

From the more detailed technical parts of this book, it will be clear that dirty electricity in the mains, i.e. the household's ordinary electrical wiring, has its counterpart in pulsing radio signals:

The two terms arise from two different professional traditions, a professional tradition which deals with electrical equipment – e.g. motors, transformers, light bulbs, switches, etc. – connected to the mains and has seen dirty electricity as a problem related to technical functional *disturbances* and fire hazards (EMC – electromagnetic compatibility), and another tradition that makes use of electricity to produce radio signals, where pulsing is essential for the transmission of information by modifying a carrier wave (*signal modulation*).

Dirty electricity and pulsing are – seen purely technically – largely the same thing in terms of how they arise – through varying voltages, even if they arise for completely different purposes: Radio signals are intentionally created, while noises in electricity in the power grid are unintended side effects from the chosen technology, or the result of bad design or inadequate technical requirements.

Further technical explanations follow in later parts.

While microwaves and health risks have received a lot of attention internationally over a number of years, "dirty electricity" is very rarely referred to as source of health problems. Some exceptions from Norwegian literature exist, though:

Ref. 53: Wulfsberg, Terje, "Påvirkes helsen din av skitten strøm?" ("Is your health affected by dirty electricity?") 1.5.2016, Nyhetsspeilet, https://www.nyhetsspeilet.no/2016/05/pavirkes-helsen-din-av-skitten-strom/

"The conclusions are as follows. 1. The level of dirty electricity is in general far too high, especially in cities and towns. Normal levels found in both houses and apartments are from 200-800 millivolts, while the ideal is below 100 millivolts. 2. With several solar panels, mobile masts near high voltage lines, smart meters, as well as the use of various electrical appliances contributing, especially heat pumps, the problem is increasing. 3. This has great importance for health. *Ailments due to EM radiation are not something that only concerns those who are described as 'electrically hypersensitive'. The only difference is that they are hit first and therefore act as whistleblowers for the rest of us.*"

* https://einarflydal.com/litteraturliste-skitten-strom/

Both within architecture and electricity, however, there is a good deal of literature on how to design solutions to mitigate electromagnetic fields in homes. So is also the case as to the design of electric cars. Hearsay is that Volkswagen in the owner's manual for electric cars at some point in time included warnings against sitting in the back seat over the batteries due to the powerful fields there. Several projects have dealt with electric fields in electric cars, e.g. The *EMSafety project*, in which the Norwegian research institute SINTEF participated. Cell damage is discussed in the project websites.

> Ref. 54: The EMSafety project (2011-2014), https://www.sintef.no/projectweb/em-safety/

The topic is thus known in several technologically focused professional circles, and was so before 2014.

Internationally, there are a few scientists who have studied dirty electricity related to health as their particular focus area. There are several references to their studies in this book.

2.8 The power and wireless industry is protected by outdated knowledge

The electricity and wireless industries work within a field where it has long been understood that biology is affected, but just partly understood how and to what extent.

The electricity and wireless industry, as well as their regulation, is based on outdated notions of how biological systems make use of electric, magnetic and electromagnetic fields, as well as how sensitive they are to such fields. Nevertheless, within these disciplines it has long been understood that such fields can have biological effects, even if one has not understood all the details as to how non-thermal effects occur. Neither has one managed to measure or quantify more than just the most evident and gross effects.

Typical is that the work within this field here in the West in recent years, has been based on an understanding of harmful effects, health effects and criteria for research assessments suitable for not taking the more subtle non-thermal effects seriously.

As a typical example of such a report, is the one commissioned by Ireland's national electricity grid company EirGrid in 2015 from an American consulting company: Here only a fairly superficial analysis was carried out on evaluations of the science by industry bodies with formal roles, conducted using formal evaluation methods, without going into whether their evaluation methods were suitable for the material being reviewed. In these evaluations, all findings of health risks and harmful effects are disqualified as "alternative" and for not being sufficiently reliable as their evaluation methods are considered not sufficiently rigorous.

> Ref. 55: Overview of Scientific Assessments of Research on ELF EMF and Health and Epidemiologic Studies, 2007-2015, Exponent, 149 Commonwealth Drive, Menlo Park, California 94025, September 8, 2015, https://bit.ly/3WIHgpE

An Official Norwegian Report (NOU) in 1995 on electromagnetic fields and health took a far more open approach. This happened during a period with a lot of discussion on health effects from ELF – extra low-frequency fields such as from household electricity and high-voltage lines. It was before ICNIRP's guidelines from 1998 had been published, where it was claimed that "sufficient evidence" in scientific research on health damage from ELF did not exist, as long as the intensity is not high enough to cause nerve stimulation sufficient to the creation of hallucinations. Several court cases had also recently been held in the United States, and in Norway, in which the claims were that high-voltage lines constituted a health hazard.

The NOU has a large number of mentions of influence from pulses as a cause to gene activation (p. 158), as a stimulus for healing fractures (p. 161-2), etc.. However, the findings are not attributed any weight, as they are not considered sufficiently confirmed, consistent or general. The NOU concludes that harmful effects from the electricity grid are uncertain. It does not at this point mention effects from pulses, which in the context of the power grid equals dirty electricity.

Although the NOU finds no reason to conclude that electromagnetic fields from the electricity grid are a cause of health effects whatsoever, it still concludes by mentioning that there are uncertainties that make caution appropriate.

> Ref. 56: Electromagnetic fields and health, Proposal for a management strategy, NOU 1995: 20, https://www.regjeringen.no/no/dokumenter/nou-1995-20/id140410/

The NOU is based on a report from an expert committee, which concludes as follows (NOU 1995, p. 8, our summary):

- Neither epidemiological nor experimental data provide a basis for classifying low-frequency electrical or magnetic fields as a certain cause of cancer.
- Neither has reliable scientific evidence been found to consider other diseases, injuries or ailments to be caused by electromagnetic fields of a nature and strength for which one may possibly be exposed in daily life, nor in most professions.
- Epidemiological studies suggest that leukaemia occurs more often among children who live near power lines than among other children, but the available data is not sufficient to determine a causal relationship. Crucial questions about possible biological mechanisms of action, how to define doses, as well as dose-effect relationship remain unanswered.
- The scientific basis for linking any carcinogenic potential from living close to power lines to the magnetic fields surrounding the wires is insufficient.
- From an administrative/governmental point of view, it may still be appropriate to classify certain areas near power lines as more riskier than others. In case, such a classification should be based on distance, and should not specify any specific causal factor.

Similar investigations were carried out in several other countries, e.g. the same year in the United States, where The National Institute of Environmental Health Sciences (NIEHS) and the U.S. The Department of Energy (DOE) published a booklet, “Electric and Magnetic Fields Associated with the Use of Electric Power” (1995), cited in (Riley 2012).

> Ref. 57: Karl Riley: Tracing EMFs in Building Wiring and Grounding, third edition, revised, 2012, ISBN: 1-4699-0201-X, p. 4

Despite the fact that the electricity industry prevailed in the courtroom and in public investigations with the notion that as long as damages were not definitely proven, restrictions should not be applied, a large number of studies emerged that demonstrated harmful effects, especially with regard to relationship between alternating current and cancer.

After an extensive literature review, IARC, i.e. the WHO Cancer Research Institute, classified low-frequency electric fields as belonging to cancer hazard class “2B, possibly carcinogenic to humans”. IARC makes such classifications only after extensive committee work, where various stakeholder groups are represented, and where there is ample opportunity for lobbying. Decisions are therefore normally “conservative”, in the sense of reluctant about setting restrictions.

Ref. 58: Static and Extremely Low-Frequency Electric and Magnetic Fields, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, (Vol. 80) (19-26 June 2001)

In Norway, the uncertainties were also emphasised in the academic committee report on which the NOU in 1995 (see Ref. 56) was based, and in textbooks, although the empirical findings were not considered sufficiently reliable evidence. As shown above, the uncertainties were not taken into account in the governmental report (the NOU), but somewhat stricter regulation was introduced with regard to minimum distance from high-voltage lines for homes, kindergartens, etc.

The uncertainties were still highlighted by the experts: A textbook on low-frequency electromagnetic fields from 2001 thus emphasises all the uncertainties that make it difficult to measure health risks – *simply because it is not known which properties of the fields are important to measure*:

Ref. 59: Arnt Inge Vistnes: "Electromagnetics at home" in Brune D, et al.: Radiation at Home, Outdoors and in the Workplace, Scandinavian Science Publisher, 2001, Chapter 19.10 Exploration of exposure, https://bit.ly/3FpJwce *

The basis for determining exposure limits or thresholds and for making risk assessments on the basis of physics or general models is therefore weak.

Eventually, analyses were made which show correlations with several other "diseases of civilization" in the presence of electrical fields. For example, Firstenberg sums up clear connections between the electrification of the rural areas in the USA and the rise of cardiovascular disease, cancer, obesity and diabetes – roughly controlled for changes in eating habits etc.:

Ref. 60: Arthur Firstenberg, 2017. The Invisible Rainbow – A History of Electricity and Life, AGB Press, Chapters 11, 12, 13, 14.

Also the wireless industry has since long been aware of health hazards, and has worked actively both to protect against health damage and to avoid restrictive limits.

Ref. 61: Martin L. Pall: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, PDF note, see Chapter 6: The Great Risks of 5G: What We Know and What We Don't Know. https://bit.ly/3jzi86x,† (republished in Norwegian and some other languages)

Knowledge of biophysical impacts from "weak" – i.e. non-thermal – fields has emerged over a long period of time, but has exploded in recent decades due to new technologies that make more direct observation possible. See e.g. the book by the biophysicist Susan Pockett:

Ref. 62: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW * See Chapter 15 Membranes

Biology is far more complex than was assumed at the time the electricity and wireless industries grew, while the industries are still today regulated based on the old knowledge, not in accordance with today's knowledge as to harmful effects.

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* https://www.researchgate.net/publication/236163732_Radiation_at_Home_Outdoors_and_in_the_Workplace

† https://einarflydal.com/wp-content/uploads/2018/04/pall-to-eu-on-5g-harm-march-2018.pdf

* https://www.safertechnology.co.nz/wp-content/uploads/2021/04/ELECTROSMOG-May-2021.pdf We relate to the Norwegian edition: Susan Pockett: Stråletåka – Helse- og miljøforurensningen fra mikrobølgene, 237 pages, Z-forlag, 2020, ISBN 978-82-93187-50-9.

It has been claimed that knowledge has not only been underestimated by these industries, but to some extent, as emerges from some of the sources above, systematically withheld and opposed in various ways, including these industries' support of scientific research based on assumptions and methods that lead to failure to prove harmful effects. This emerges from some of the sources mentioned above, and will be demonstrated again in later sections of this book.

Accordingly, it may well be argued that these industries – and their regulatory counterparts – are introducing technologies that have significant impact on health and the environment, without sufficient knowledge, without adequate consideration for this problem, and without prior environmental impact assessments, which given the state of evidence, should have been considered mandatory.

2.9 Harmful effects and hypersensitivity are related to the growth in electricity consumption

In this section, extensive biological harmful effects to the environment, morbidity and health problems, including electro-hypersensitivity, are linked to the sharp increase in microwaves and power consumption.

The tremendous growth in consumption and the extensive presence of man-made electricity does not only apply to radio signals (see Figure 7), but also to the consumption electricity – today leading to extensive damage to health and threatening the environmental ecosystems. The physical, biophysical and medical mechanisms behind this are in part known, in part unknown or only partially understood. Nevertheless, the links can be demonstrated.

Therefore, there is a strong and growing recognition in professional communities around the world that this growth has now become a significant health and environmental problem, that there is a need for further restrictions and technical alternatives, and that the industry's and authorities' claim that no harmful effects can be demonstrated, simply lacks credibility.

For a list of 38 appeals (as per 2018) from medical doctors and scientific researchers in the field, see:

> Ref. 63: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, pp. 131-134, or from p. 34 in https://bit.ly/3PYwo4U For full ref, see Ref. 11.

Also, in 2018, an international panel of environmental scientists included the harm done to wildlife from microwave radiation in its annual rating of the upcoming 15 most important environmental issues. The panel is funded by the UK's *Natural Environmental Research Council* and *Royal Society for the Protection of Birds*.

> Ref. 64: William J. Sutherland, Stuart H.M. Butchart, Ben Connor, Caroline Culshaw, Lynn V. Dicks, Jason Dinsdale, Helen Doran, Abigail C. Entwistle, Erica Fleishman, David W. Gibbons, Zhigang Jiang, Brandon Keim, Xavier Le Roux, Fiona A. Lickorish, Paul Markillie, Kathryn A. Monk, Diana Mortimer, James W. Pearce-Higgins, Lloyd S. Peck, Jules Pretty, Colleen L. Seymour, Mark D. Spalding, Femke H. Tonneijck, and Rosalind A. Gleave: A 2018 Horizon Scan of Emerging Issues for Global Conservation and Biological Diversity, Trends in Ecology & Evolution, January 2018, Vol. 33, No. 1 https://doi.org/10.1016/j.tree.2017.11.006

Some people and some creatures in the environment are more sensitive to this new, man-made agent than others, and react with acute symptoms. Some become very affected after even a short period of exposure. Others only react to the biological stress caused by the exposure after some longer period.

The reaction pattern may in short be described by established environmental medicine as standard reactions of biological stress – at first an acute, non-specific response from the sympathetic nervous system, followed after a shorter or longer period of time by further non-specific responses in the form of failures of some regulatory systems.

A comprehensive review of Soviet research literature between 1960 and 1996 shows that this understanding has been present since long ago:

> Ref. 65: Hecht, K.; H.-U. Balzer (1997): Biologische Wirkungen elektromagnetischer Felder im Frequenzbereich 0 bis 3 GHz auf den Menschen. (Biological effects of electromagnetic fields in the frequency range 0 to 3 GHz on humans.) Commissioned by the Bundesinstitut für Telekommunikation. Contract no. 4231/630402.

The general explanatory model given in this source for acute and long-term biological impact through biological stress is shown graphically in Fig. 52. It is also briefly summarised here:

> Ref. 66: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3* Part 2, Section 13

2.10 On electro-hypersensitivity in particular

Here, evidence is provided that electro-hypersensitivity is a reality, triggered by EMF. The fact that such extra sensitivity can exist, challenges today's exposure limits and the radiation protection regimes based on them: If the EHS reactions are real and triggered by electromagnetic fields, the exposure limits are not restrictive enough, and not relevant to protection health and the environment against being damaged.

The term “electro-hypersensitivity” (EHS) is used to designate acute reactions to electromagnetic fields weaker than the authorities' (recommended) exposure limits. Also, the term is used in the meaning of “extra high sensitivity”, i.e. as a label for sensitivity causing stronger or more serious or significant symptoms than what is usual and/or expected.

The term itself is thus unclear and therefore unscientific, but denotes conditions for which there are extensive observations: Some of people react acutely to EMF exposure, while others do not.

The defence of today's exposure limits includes claims that electro-hypersensitivity cannot be caused by exposure to EMF, but must have others explanations, possibly psychological: If the biophysical connection to EMF is accepted, the *thermal paradigm* fails.

Ever since the earliest exploration of the health effects of electricity at the end of the 18th century, there have been reports of serious morbidity developing over time, therapeutic effects, and milder or particularly strong, acute symptoms in individuals and animals, triggered by exposure to even very weak electromagnetic fields.

> Ref. 67: Arthur Firstenberg, 2017. The Invisible Rainbow – A History of Electricity and Life, AGB Press (translated into Norwegian 2018), especially Chapters 1 and 2.

In the middle of the 19th century, when telegraphy and household electricity were introduced, large population groups got exposed to electric fields within a short time in cities, giving rise to *neurasthenia*, a disease of civilization in which the new electrical environment, together with other environmental stressors, was a key component (Firstenberg 2018, p. 69 –). (According to

* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

Firstenberg, the term *neurasthenia* was later redefined by Freud as purely a psychosocial disorder, but is still in use in its original meaning in parts of the world.)

Reactions to electromagnetic fields have over the years received many different designations, including the following:

> Radio Wave Sickness (Germany 1932), Microwave Syndrome (Poland 1964), Microwave Sickness (Poland 1973), Neurological (Asthenia) Syndrome (Russia 1964), Autonomic Vascular Syndrome (Russia 1964), Cardiac Syndrome (Russia 1964), Neuro-vegetative Asthenic Syndrome (Russia 2001), Cardiac Pain Syndrome (1973), Diplomats' Disease (1976), Visual Display Unit Illness (1977), Electrical Sensitivities (1986), Electrical Hypersensitivity (1989), Electromagnetic Hypersensitivity (1994), Electromagnetic Sensitivity (1991), Electro hyper-sensitivity (EHS), Asthenic Syndrome (2009), Membrane Sensitivity Syndrome (2008), Microwave Disease, Microwave Syndrome, Radiofrequency (RF) Sickness, Rapid Ageing Syndrome, Electrical hypersensitivity, Electrical allergy, Electrosensitivity (ES), Radio sickness, Radiation sickness, Radar sickness, Electro-stress, Environmental Intolerance with attribution to EMF (IEI-EMF), Electromagnetic field intolerance syndrome (EMFIS), Microwave sickness, Microwave syndrome, Microwave hearing, Wi-Fi syndrome, Electromagnetic hypersensitivity, Neurasthenia

There is a very large number of medical reports, research studies and literature collections of observations about the phenomenon, although the biophysical mechanisms that explain the large individual variations have not been clarified.

For a comprehensive list of research literature on electro-hypersensitivity, with summaries, see:

> Ref. 68: Excerpt from “Electromagnetic hypersensitivity means Peter Lloyd can't leave his house... or enjoy any modern pleasures inside” by Martin Shipton, Wales Online, Oct 16, 2014, updated March 2022, shortlink https://bit.ly/3hOpZN3*

Thus, although such sensitivity cannot be explained in every detail, it can be observed and made the subject of (double)blinded tests, although this is difficult since the test conditions easily affect the outcomes, the sensitivities are so individually different, and EHS people are reluctant to undergo such tests as they get sick, maybe very sick, from the exposure.

Those tests that have turned out to have a high hit rate, are tests where a first screening filters out those who are convinced they are EHS, but are in fact not. Then the ones who pass the test, are blindly tested repeatedly, with long enough breaks to recover, being exposed to exactly the kind of exposure and source found to make them ill. If they identify the exposure situations correctly, EHS is real. If, on the other hand, they react – or think they react – completely at random, one cannot know if EHS is real, only that those individuals are not EHS, and the individuals tested and/or the test procedure and conditions might have to be revised. A simple version of such a test was carried out by Danmarks Radio (DR2), with a particularly high hit rate:

> Ref. 69: Test of electrically hypersensitive, Danmarks Radio, shortlink; https://youtu.be/_xeWmi9M1_M

A test based on a more elaborate version of this procedure was carried out on a somewhat larger number of people in 1991, also with a particularly high hit rate:

> Ref. 70: Rea, William & al, Electromagnetic Field Sensitivity, Journal of Bioelectricity, 10 (1&2), 241-256, 1991, https://bit.ly/3Cz60sQ †

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* https://www.saferemr.com/2014/10/electromagnetic-hypersensitivity_30.html

† https://einarflydal.com/wp-content/uploads/2023/01/Rea-1991-Electromagnetic-Field-Sensitivity.pdf

This type of test filters out the normally rather few people who mistakenly attribute EMF as the cause of their health problems. Then it tests more extensively those individuals who did initially react to exposure in blinded tests. They should be quite easy to carry out, but they require testing on just the type of exposure (WiFi router / mobile phone charger / car charger, LED light bulb ...) that the people are actually found to react to, and in the setting where they were found to react during the screening. Such a test procedure would verify EHS as a reality if positive findings are made. The claim EHS being a psychological phenomenon without a biophysical basis, would then be falsified. So far, this type of tests has given a very high percentages of hits – close to 100%. As far as we know, such tests have never been carried out by the research communities that defend today's exposure limits, neither in any tests financed by the industry.

The opposite test approach would be to do random sampling of the population and test at a fixed frequency, perhaps even with no pulses, i.e. just the carrier wave of a radio signal or a 50/50 Hz sine curve as in electrical current with no dirty electricity. The chances for making statistically significant findings are then very poor: Few are hypersensitive, not everyone reacts quickly – maybe only after a day, they react to various types of EMF, and non-pulsed fields give by far less reactions. Some might react primarily when several environmental factors interact, and so on.

Such rigid tests are frequently used as “proofs” for claims that EHS does not seem to be caused by EMFs. They formed the basis for the committee report constituting a major part of the platform on which the current Norwegian policy as to EHS is built, the report being

> Ref. 71: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012*

An important basis as to the considerations on EHS in this important committee report was a brief report commissioned by the Ministry of Health from the ICNIRP member to become, Gunnhild Oftedal:

> Ref. 72: Oftedal, Gunnhild: “Electro-hypersensitivity – investigation into causes and possible measures and treatment plans”, Report (Norwegian), Sør-Trøndelag University college, Department of Technology, 2006, https://bit.ly/3CD7L8g †

However, the test methods applied in the studies on which that investigation drew its conclusions of EHS probably not being related to EMF exposure, are today, by the very same scientific researcher, considered flawed and unacceptable, as are all other studies until now:

> Ref. 73: Schmiedchen, K., Driessen, S. & Oftedal, G. Methodological limitations in experimental studies on symptom development in individuals with idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF) – a systematic review. Environ Health 18, 88 (2019). https://doi.org/10.1186/s12940-019-0519-x

The researcher who primarily was responsible for the experiments constructing the notion of EHS as a *purely psychological phenomenon,* biophysically unrelated to EMFs, seems to be Dr. James Rubin, King's College, London.

> Ref. 74: Rubin, GJ, Hillert, L, Nieto-Hernandez, R, van Rongen, E, Oftedal, G: Do People With Idiopathic Environmental Intolerance Attributed to Electromagnetic Fields Display

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* “Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis”, (Norwegian with English summary) https://bit.ly/3Cu9IDW, or https://www.fhi.no/globalassets/2012-3_mobilstraling

† El-overfølsomhet – utredning om årsaker og mulige tiltak og behandlingsopplegg (Norwegian), https://einarflydal.com/wp-content/uploads/2023/01/Rea-1991-Electromagnetic-Field-Sensitivity.pdf

Physiological Effects When Exposed to Electromagnetic Fields? A Systematic Review of Provocation Studies, Wiley, 2011

An example of how Dr. Rubin's testing procedures failed at the most elementary, is found in Brian Stein's minutes as a “guinea pig” in one of these experiments:

Ref. 75: Stein, Brian & Mantle, Jonathan: The Microwave Delusion, Grosvenor House Publishing, 2020, pp. 35-39.

Stein tells from his experiences as a subject for Rubin that the testing protocol was set up so that the most sensitive individuals, those who could not risk becoming exposed, or not able to complete the test due to their own strong reactions, were excluded from test and thereby from the reported findings: Stein's own violent, acute reactions to exposure, such as haemorrhage on repeated occasions, made him unable to follow the entire test protocol. So, as he did not finish, he and his test results were simply omitted from the project report, which concluded that no connection between exposure and symptoms were found!

The European Economic and Social Committee (EESC) stated in 2015 in a paper, that it acknowledges and is concerned as to the rise in electro-hypersensitivity (EHS):

Ref. 76: Opinion of the European Economic and Social Committee on 'Electromagnetic hypersensitivity', (own-initiative opinion), (2015/C 242/05), https://bit.ly/3FQBVWo *

“1.1 The EESC acknowledges and is concerned about the prevalence of EHS. It is encouraged to note that further substantial research is ongoing to understand the problem and its causes..

1.6 The Committee notes that EHS sufferers experience real symptoms. Efforts should be made to improve their health conditions with a focus on reducing disability as detailed in Biomedicine and Molecular Biosciences COST Action BM0704 (BMBS COST Action BM0704 Emerging EMF Technologies and Health Risk Management).”

The introduction of office computers and monitors in the early 1980s, led to a large number of “screen-damaged” electrically hypersensitive individuals.

Ref. 76b: Granlund-Lind, Rigmor & Lind, John: Black on White. Voices and Witnesses about Electrohypersensitivity. The Swedish experience, 2005, https://bit.ly/3YUO5X2 †

Sweden has since then recognised electro-hypersensitivity as a disability. This is reflected, for example, in the The Swedish National Board of Housing, Building and Planning’s recommendations for how to shield electrical equipment in homes to shield against weak electromagnetic fields, including dirty electricity from modern electronics:

Ref. 77: Improved electrical environment in new construction – Furiren 3 in Kristianstad. (PDF) The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-497-8. 36 pages‡

Ref. 78: (PDF) The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-481-1, 34 pages§

* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014IE5117&from=PL

† https://einarflydal.com/sdm_downloads/granlund-lind-r-lind-j-black-on-white-voices-and-witnesses-about-electrohypersensitivity-2005/

‡ Förbättrad elmiljö vid nybyggnad – Furiren 3 i Kristianstad (Swedish)

Ref. 79: Improved electrical environment – measures to reduce electrical and magnetic fields fields in housing) (PDF, approx. 6 MB). The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-503-6. 44 pages*

Ref. 80: Extensive sanitation – Measures to reduce electrical and magnetic fields in homes. (PDF) The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-508-7. 40 pages†

These most valuable documents, Ref. 77 – 80, may be *read* at this link: https://bit.ly/3WRIi2F ‡, but not downloaded. Upon request, the Swedish National Board of Housing, Building and Planning refused this author (EF) to make them available for public download. They should still be available from libraries.)

All these guidelines were issued by the Swedish National Board of Housing, Building and Planning the same year as ICNIRP's 1998 guidelines, its first, were published. These Swedish guidelines state that reacting to pulsed EMF and to dirty electricity should be considered normal a fairly normal phenomenon. These guidelines are thus contrary to ICNIRP guidelines. One may suspect that is why our request to make them available for download was turned down.

As we see, the controversy over the cause behind EHS has been essential for the defence of the thermally based exposure limits.

A formal handling method has developed in which health authorities according to which they on the one hand acknowledge that those who plead EHS, have obvious and real health issues which must be taken seriously and treated with respect, while on the other hand, the health authorities will not accept the cause of that health problem to be EMF exposure, as this would come into conflict with the ICNIRP guidelines, the WHO Geneva (where the ICNIRP affiliate WHO's The International EMF Project is situated, and downwards to the national Radiation Protection Authorities (like the Norwegian DSA).

This means that national health authorities cannot permit themselves to admit the quite obvious and cannot accept, as experience shows, what stands out as the most effective treatment, which is removing radiation sources, shielding, and distancing. Instead, they recommend *cognitive therapy*, which does not run contrary to the foundations of the radiation protection policy, however the results of cognitive therapy have been very poor.

A kind of peak was reached in 2004: The ICNIRP dominated WHO working group assembled in Prague in 2004 to discuss their understanding of electro-hypersensitivity, advised against exposure measurements and shielding as favourable measures for people who claim getting symptoms from EMFs. The rationale was that such measures would just enforce their (supposedly false) beliefs that their health problems actually being caused by man-made EMFs!

Ref. 81: WHO Work Group Meeting Report of WHO workshop on electro-hypersensitivity 25-27 October 2004, Prague, Czech Republic. 2005, https://bit.ly/3VvyiuN §

§ God elmiljö från början – Erfarenheter från konsultbranschen (Good electricity environment from the start – Experiences from the consulting industry (Swedish)

* Förbättrad elmiljö – åtgärder för att minska elektriska och magnetiska fält i bostäder (Swedish)

† Omfattande elsanering – Åtgärder för att minska elektriska och magnetiska fält i bostäder (Swedish)

‡ https://einarflydal.com/2021/02/28/interessert-i-el-miljo-i-boliger-https://einarflydal.com/2021/02/28/interessert-i-el-miljo-i-boliger-k-her/)

§ https://www.who.int/docs/default-source/documents/radiation/who-workshop-on-electrical-hypersensitivity.pdf?sfvrsn=f12c3b9e_1

During this WHO work group meeting, the term IEI-EMF, *Idiopathic environmental intolerance (Electromagnetic field attributed symptoms)*, was coined, a term alluding that there be no real connection to EMFs, or – at least – that the connection had not been proven. To several of the participants, this was a conclusion not in line with much of the material presented, which gave reasonable evidence for such a connection.

Later parts of this book refer to more research material and observations that substantiate acute health complaints and strong symptoms as resulting from exposure to sub-thermal EMF – whatever we choose to call it.

2.11 Long-term adverse effects on health

Electro-hypersensitivity is primarily associated with acute health problems. Long-term harmful effects on health from EMF exposure are less spectacular and less urgent. However, such knowledge has been gathered for more than 90 years. The first German report on cumulative long-term effects of weak microwave radiation was published in 1932, according to

> Ref. 82: Hecht, K. "Health Implications of Long-term Exposure to Electrosmog", Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V. 2016, https://bit.ly/3IzdNut *

Since 1932, such harmful effects have been confirmed a number of times – and often described as *microwave syndrome*, i.e. a collection of typical health effects which occur individually or together clearly more often in long-term exposed people than in the rest of the population. In his summary, the veteran scientist Karl Hecht mentions, among others, the following studies which gave rise to the same conclusions – harmful effects found. Some were commissioned by the United States Armed Forces, others as part of the Soviet Union's very extensive research into health-damaging as well as beneficial health effects:

> Abramowitsch-Poljakow et al. 1974;
> Bojzow and Osinzewa 1984;
> Drug China 1960;
> Drogitschina and Sadschikova 1968, 1965, 1964;
> Drogitschino et al. 1966;
> Frey 1963a and b, 1962, 1961;
> Garkawi et al. 1984;
> Ginsburg and Sadtschikowa 1964;
> Krylow et al. 1982;
> Marha et al. 1968/71;
> Marino 1988;
> McLaughlin 1962;
> Medvedev 1973;
> Moros 1984;
> Owsjannikov 1973;
> Pawlowa und Drogitischina 1968;
> Plechanov 1984;
> Rakitin 1977;

* https://kompetenzinitiative.com/wp-content/uploads/2019/08/KI_Brochure-6_K_Hecht_web.pdf, English edited version of the original "Der Wert der Grenzwerte für Handystrahlungen", 2009, https://bit.ly/3GnHhd9, or https://kompetenzinitiative.com/wp-content/uploads/2019/08/hechtgrenzwertekiint20090109.pdf

Sadtschikowa 1964;
Sadtschikowa et al. 1972, 1971;
Szmigielski 1977;
Tjashelova 1983.

Many more studies are referenced in the present book. Here we are talking about symptoms that imply a number of serious conditions. Hence, to claim that adverse effects, and/or the damage potential, have not been documented, thus appears as manifestly unreasonable.

2.12 Health effects from AMS meters: just classical microwave sickness

This section emphasizes the need to look at the syndrome, i.e. the symptoms as a whole, not just the symptoms one by one, in order to discover the relationship with EMF exposure.

It is clear from biophysics professional and medical sources, e.g. (Pockett 2021, see Ref. 62) that it is not feasible to be very specific about which symptoms are caused by AMS meters: There are no one-to-one relationships between the stressor in its many forms and various effects.

Since fundamental mechanisms are affected, the effects may occur in very different areas, i.e. parts of a living system or sub-system: “Electrosmog” may spread out an appear through many different symptoms.

If you look at the symptoms individually, they typically fall into the huge category of *MUS – (in Norwegian MUPS, for Medically Unexplained Ailments and Symptoms)*. The label “MUS” is used to characterize long-term, bothersome and/or disabling symptoms, for which the doctor does not know the cause(s). Such symptoms constitute some 25 – 50% of patients’ symptoms found by medical doctors. The Norwegian Medical Association's sub-committee for MUS emphasizes that “MUSs” are:

> Ref. 83: Medically Unexplained Ailments and Symptoms (MUPS), The Norwegian Medical Association's sub-committee for MUPS, https://bit.ly/3jVAE94 *
>
> “More or less unexplained but in no way “inexplicable”. There is a lot of research-based knowledge in the field, which it is important to make known.”

Health complaints that do not lead to objectively observable results such as rashes, but are only experienced by the patient himself, such as headaches, migraines, fatigue, etc., are classified as *subjective symptoms*. In the WHO classification system ICD-10, *subjective symptoms* are given a separate code (R68.8), and referred to as *idiopathic*, i.e. experienced by the individual, no clear cause found, but attributed to some environmental stressor.

Health complaints classified as subjective symptoms, i.e. without objective finds, are easily “psychologised”, or made into a question of what the patient could do himself to cope with everyday life. This latter focus is emphasized in the following interview with medical doctor and senior researcher Aase Aamland. With her Ph.D on “MUS” and leader of the Norwegian Medical Association’s Work group on MUPS. she speaks about “the heart-sinkers”, i.e. the patients with presumed unexplainable symptoms who make the practitioners’ heart sink, as they are mostly unable to help them, although their conditions might not be so inexplicable as commonly believed:

* Medisinsk uforklarte plager og symptomer (MUPS) (Norwegian), https://www.legeforeningen.no/foreningsledd/fagmed/norsk-forening-for-allmennmedisin/faggrupper/medisinsk-uforklarte-plager-og-symptomer-mups/

Ref. 84: Rune Skogheim: “The Song of Sinking Hearts”, interview, Journal of the Norwegian Medical Association, https://bit.ly/3Znt3QV †

Acknowledging that exposure to electromagnetic fields trigger purely biophysical mechanisms makes it well understandable and likely that reactions will not be specific, neither the acute ones nor those that may occur over time. In stead, they may vary widely from individual to individual, and so more or less randomly, even when the underlying biophysical mechanisms are largely the same. In other words, they just seem to be inexplicable as long as one does not have an understanding of the underlying mechanisms.

The fact that the reactions will not be specific, but spread over a large register of reactions, can be illustrated as shown in Figure 8. Here, the causal chain creates and maintains *oxidative stress*, also referred to as *cell inflammatio*n.

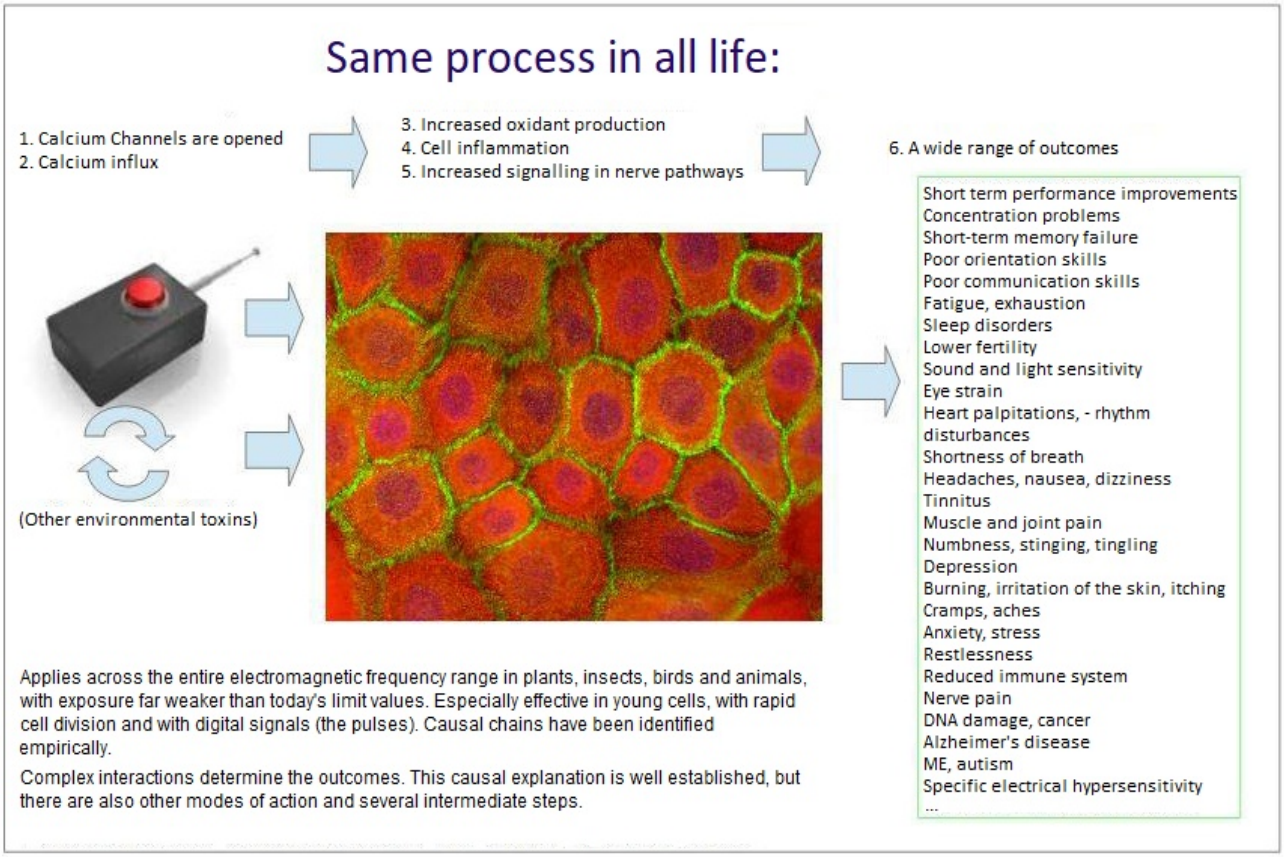

Figure 8: Illustration of elevated calcium influx as an explanation for a long series MUS (translation from E Flydal, lecture material)

Figure 8 shows a “fan” of different resulting outcomes (right) springing from the same basic mechanism – *increased calcium uptake in cells*. Such increased calcium uptake can be triggered by several different environmental stressors, man-made EMFs being one of them – most likely also by several stressors in interaction (*constructive interference/interaction effects*).

† De synkende hjerters sang (Norwegian, interview), https://tidsskriftet.no/2017/10/intervju/de-synkende-hjerters-sang

Figure 8 is a popularization of Figure 9, here taken from Huber & Baehr (2014). In Figure 9, a feedback loop is also included (top right) which shows the *development of increased sensitivity* to some specific stressor: “The body learns to react” to specific environmental toxins.

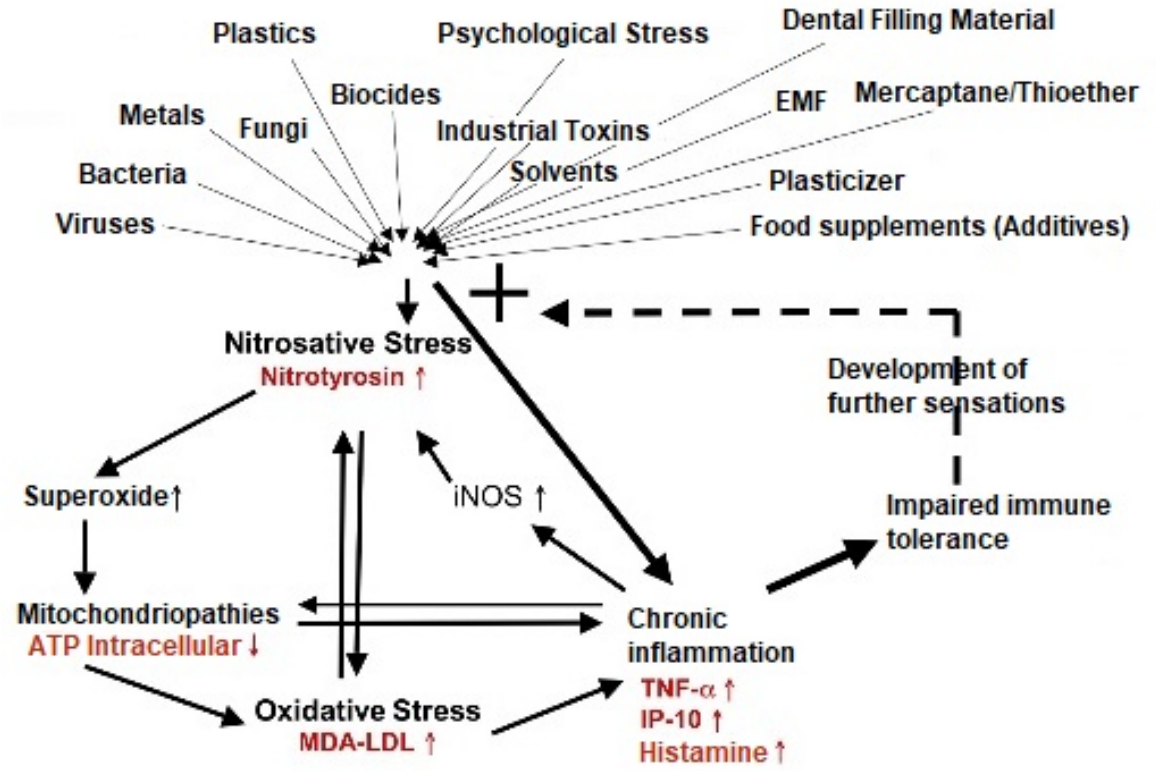

Figure 9: Oxidative stress model, with feedback (dotted line) showing development of hypersensitivity (from Huber & Baehr 2014, our translation)

> Ref. 85: Wolfgang Huber and Volker von Baehr: Chronic systemic inflammatory diseases – A standardized diagnostic method leads to targeted therapy, (German), Umwelt·Medizin·Gesellschaft, (a journal for environmental medicine), 27, 4/2014, p. 271 et seq., https://bit.ly/3YTHImI *

This same explanatory model – without EMFs indicated as an environmental stressor – became widely known around 2005-8, and has, as shown in Figures 8 and 9, “explanatory power” to account for a number of MUS. It is now widely known and accepted within environmental medicine.

> Ref. 86: Pall M. L. 2007 Explaining 'Unexplained Illness': Disease Paradigm for Chronic Fatigue Syndrome, Multiple Chemical Sensitivity, Fibromyalgia, Post-Traumatic Stress Disorder, Gulf War Syndrome and Others, Harrington Park (Haworth) Press.

The model is reproduced in many research publications. Huber & Baehr (2014) refers to it as a standard model for understanding the typical disorders of our time, as they be related to the loss of immune tolerance in the face of environmental pollution.

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* Chronische Systemische Entzündungserkrankungen – eine standardisierte Diagnostik führt zur zielgerichteten Therapie, https://www.inflammatio.de/fileadmin/user_upload/Diag_Info/Prof_W_Huber_2014_Chron_Entzuendung_Diagnostik_Therapie.pdf

That EMFs belong among the environmental stressors that can trigger such oxidative stress, and the subsequent hypersensitivity, has been known for a long time, was “relaunched” by Martin L. Pall as an explanation in 2013, and quickly became world known well beyond the medical profession.

> Ref. 87: Pall ML. 2013 Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J Cell Mol Med 17:958-965.

Still, considering (man-made) EMFs as an environmental stressor even at weak exposure strengths is relatively rarely accepted in the health sector of many countries, and is in Norway not reflected in the medical education, not even in the education in occupational and environmental medicine. (Such a view on EMF effects carries with it strong criticism of the current exposure limits.)

Since the symptoms from EMF exposure are so varied, empirical studies looking at associations between individual symptoms and EMFs as the triggering cause, may find it difficult to find any clear connections: The symptoms are so diffuse and spread out over so many diagnoses on just some few percent of the population.

Hence, statistical significance might only be found when subsets are studied. The symptoms should therefore be regarded as part of a cluster of symptoms, i.e. as a syndrome. Several researchers therefore argue that *the overall picture of symptoms* in the group should be taken into consideration, not just individuals. They argue that the reactions on both AMS meters and other transmitting equipment are typical and identical to what is known as *microwave sickness*. Professors Claude Monnet and Pierre le Ruz, PhDs in radiology and physiology respectively, summarise the knowledge status, symptoms and mechanisms on a three-page pamphlet:

> Ref. 88: Claude Monnet and Pierre le Ruz: The Microwave Syndrome, undated “factsheet”, https://bit.ly/3wbLcEd *

We shall see later that one of today's most prominent American research communities recently concluded microwave sickness syndrome to be the likely explanation to the health issues of the diplomats from the USA and Canada who suffered health problems in Havana, Guangzhou and some other places, reported in newspapers during the last few years. The topic of EHS as a syndrome is also discussed in more detail in several of the expert testimonials mentioned below.

2.13 Expert testimonials, reports and notes on AMS meters

In this section the reader will find extracts and references to a number of expert testimonials pointing to AMS meters, dirty electricity and pulses as causes of significant health and environmental issues.

Here are listed some legal expert testimonials, reports etc. where accounts are given of ascertained and/or foreseeable health and environmental harmful effects from wireless AMS meters. The list is certainly incomplete. To some of these references, we have added our comments.

Some published scientific studies are also included. These are quite few, for obvious reasons:

The first deployments of AMS meters began in the early 2000s. From planning and financing to publication in scientific journals, it normally takes years. However, as the general properties of radiation from wireless AMS meters are well known from prior studies (referred to many places in this book), much of what is brought forward here, are results from studies of impacts from such properties, studied in different contexts. However, the two following studies show there is conformity between the results from such studies, the clinical experiences of medical practitioners,

* https://einarflydal.com/wp-content/uploads/2019/01/MicrowaveSyndrome012007Uk.pdf

and various individuals' experiences with smart meters and other technologies with similar properties. (We collected around 150 stories (in Norwegian), see Ref. 1.)

In Beety's report (Ref. 89) it is pointed out that in the laboratory test undertaken by the US regulatory authority FCC to measure radio frequency radiation, the AMS meters were tested *under very unrealistic conditions, compared to when connected to the house wiring, where the wiring will act as an antenna and make the radio frequency radiation far stronger*.

Beety's remark about the house wiring acting as a 3D antenna is fully in line with the claims and explanations given in this book (Chapter 3).

In addition, Beety mentions that dirty electricity from the meter is not subject to regulations with regard to the radio frequency radiation it creates (which is neither the case in Norway). In contrast, the meters are subject to EMC regulations, to protect the functioning of technical equipment:

> Ref. 89: Beety, Nina: Overview: Fire and Electrical Hazards from 'Smart', Wireless, PLC, and Digital Utility Meters, paper, July, 2019, page 25, https://bit.ly/3WL2za0:*
>
> "AMR Meter Lab Testing Fails to Simulate in Situ Wiring. The lab testing of the AMR meters employed a simple power cord temporarily attached to the meter mounted in a panel. The meter does not normally employ a power cord. This approach does not simulate the manner in which the house wiring feeds through the electric meter. The meter has two power connections: one entering the meter typically from the top to deliver power to the meter and another exiting the bottom of rear of the meter panel to supply power to the main breaker panel. Using a power cord instead of setting up the power wiring the way the device is actually used may not reveal how the house circuit wiring through the meter may act. The actual in situ wiring may be more like an antenna that may pick up unwanted RF energy and noise within the meter and conduct it into the residence. See photo appended to this report [p. 15-16]
>
> Other noise frequencies above 30Hz caused by the switched mode power supply would not be regulated by FCC Part 15 either."

Beety's report primarily discusses the fire risk. In that connection it also tells about *oxidative stress* as a result of smart meters, and that such stress has been observed on trees having deteriorated in health, as an increased release of volatile oils, causing a higher risk of fire (page 34):

> "**Increasing terpene production in surrounding trees due to stress**.
> Studies have shown significant stress, injury, and death to trees from RF exposure due to cell towers and radar, and the public has reported rapid negative health changes to trees following Smart Meter roll-outs. This occurred in Monterey. Trees produce terpenes – volatile oils that are aerosols – under normal conditions. When trees are stressed or injured, they emit more terpenes. Increased volatile oils due to wireless radiation exposure would create a more flammable environment for fire."

At this point, Beety's comments supplement observations of harmful effects from microwaves on trees found in a number of studies, see for example (Breunig 2017) and sources cited there:

* https://smartmeterharm.files.wordpress.com/2019/07/fire-and-electrical-hazards-report.pdf

> Ref. 90: Helmut Breunig: Tree damage caused by mobile phone base stations – An observation guide, March 2017, English version from German original: https://bit.ly/3C7dPp4 *

David Carpenter, medical doctor, researcher on EMF and health and Dean of the Department of Public Health, University at Albany, USA, writes in a petition signed by more than 50 other scientists:

> Ref. 91: Carpenter, David et al.: "Correcting the Gross Misinformation", La Maison du 21e siecle, June 17, 2012, https://bit.ly/3Vovvna †

as he also stated in

> Ref. 91b: Carpenter, David Testimony before the Michigan Public Service Commission, https://sforce.co/3hViTX1 ‡
>
> "While smart meters are too new for there to be human health studies specifically on exposure from smart meters, there is a strong body of evidence that demonstrates a variety of adverse human health effects, including cancer and effects on brain and behavior, coming from exposure to radiofrequency radiation like that generated by wireless smart meters."

In a letter to the Commission for Electricity Supply in North Carolina, USA, the same David Carpenter along with other prominent medical doctors and scientific researchers on health effects from electromagnetic fields, writes that the radio frequency fields from wireless AMS meters are characterised by *particularly numerous and powerful pulses which are particularly harmful*, and that in addition to cancer, there is increasing scientific evidence that such exposure from AMS meters is a significant cause behind the significant proportion of EHS in the population, expressed through a range of diffuse health problems (otherwise known as symptoms of microwave sickness):

> Ref. 92: Carpenter, David, Hardell, Lennart, Havas, Magda, Herbert, Martha and Milham, Sam: Subject: Docket Number E-7 Sub 1115- Smart Meter Opt-Out Fees, Letter to the North Carolina Utilities Commission, August 2, 2016, (page 1, *our emphasis*), https://bit.ly/3Wtx4BG §
>
> "Because smart meter exposure over a 24 hour period can be very prolonged (pulses can average 9,600 times a day), and because there is building evidence that the sharp, high intensity pulses are particularly harmful, the cell phone study findings are applicable when discussing adverse health impacts from smart meters.
>
> While the strongest evidence for hazards coming from RFR is for cancer, there is a growing body of evidence that some people develop a condition called electrohypersensitivity (EHS). These individuals respond to being in the presence of RFR with a variety of symptoms, including headache, fatigue, memory loss, ringing in the ears, "brain fog" and burning, tingling and itchy skin. Some reports indicate that up to three percent of the population may develop these symptoms, and that exposure to smart meters is a trigger for development of EHS.
>
> … Cell phone RFR is concentrated, affecting the head or the area where the phone stored, whereas smart meter RFR affects the entire body [equally]."

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* https://kompetenzinitiative.com/wp-content/uploads/2019/08/2017_Observation_Guide_ENG_FINAL_RED.pdf

† https://maisonsaine.ca/actualites/smart-meters-correcting-the-gross-misinformation

‡ https://mi-psc.force.com/sfc/servlet.shepherd/version/download/068t0000001UMnYAAW

§ https://ehtrust.org/wp-content/uploads/Carpenter-Letter.pdf

In an expert testimony in 2015 before a Commission on Public Services in Michigan, USA, Prof. Carpenter states that due to the health hazards indicated in scientific research, installation of wireless AMS meters cannot be justified:

> Ref. 93: Carpenter, David: Testimony on Smartmeters for Michigan Public Service Commission by Dr. David Carpenter May 22 2015, Before The Michigan Public Service Commission, with attachments, (page 3 onwards), https://bit.ly/3FYwWTD *
>
> "Q: Do you have an opinion, based on your professional knowledge and experience, as to whether the widespread deployment of radio transmitting smart meters is a safe and prudent course of action, given the present state of knowledge concerning the effects of such radio transmissions upon biological processes?
>
> A: I do. My belief is that such widespread deployment cannot be justified at this time based on the peer-reviewed research we have. I would say that universal deployment of such meters throughout our urban areas amount to an experiment on the people living in those areas, an experiment without the consent of the experimental subjects.."
>
> Q: Can you substantiate that point?
>
> Yes. In 2012 I was asked to write my concerns about the health hazards of smart meters. Forty five medical professionals and scientists, who together have authored hundreds of peer-reviewed articles on the effects of electromagnetic radiation, joined together with me in a statement expressing our views on the effects of low level radio frequency and microwave radiation in general and smart meter radiation in particular. That statement is attached to my testimony as Exhibit One.
>
> Q: To the best of your knowledge, what percentage of the general public could be called "electro-sensitive", i.e. people who experience more or less immediate symptoms when exposed to electromagnetic radiation, such as headaches, mental confusion, rapid heartbeat and so on?
>
> A: While the evidence is incomplete for several reasons, most reports indicate that between 5 and 10% of the population show symptoms of electrical hypersensitivity.
>
> Q: Is it possible that electro-sensitive people are like the canary in the mine? Or, more precisely, is it possible that the kind of electromagnetic fields that cause electro-sensitive people to experience immediate symptoms of distress, are also the kind of fields that are likely to cause long term illness to a much larger group of individuals who do not experience immediate symptoms?
>
> A. Yes, this is not only possible but likely.
>
> Q: So would it be fair to say that from a public health standpoint, protecting the most vulnerable among us might well be viewed not only as an act of compassion toward them but also have the effect of protecting the majority of the population from long term diseases like cancer or neurological diseases like Alzheimer's Disease?
>
> A: This is true.
>
> Page 7: Q: Is there anything else you would like to add to your testimony today?
>
> A: Exposure to radiofrequency radiation has been shown to result in human disease, and we should take every step within reason to avoid increased exposure. All the benefits of a smart

* https://ehtrust.org/wp-content/uploads/testimony-of-dr-david-carpenter-with-exhibits.pdf

grid technology could be obtained with wired smart meters without increasing the risk of exposure and human disease. But at the very least everyone should have the opportunity to opt-out of having wireless smart meters placed on [the outer wall of] their home."

The biochemist Richard Conrad discusses health effects of wireless AMS meters in several articles. He points to the large amount of scientific research demonstrating health effects from pulsed microwaves, often "several orders of magnitude below the exposure limits", and argues that *peak values*, i.e. the energy levels reached at "the amplitude tops" of the strongest pulses, are more important than the average intensity from such radiation, and that continuous exposure to the sharp and strong pulses from AMS meters therefore has more impact than radiation from the much shorter duration of mobile phone use, where pulse peaks are also less intense.

Conrad highlights the WHO's hazard classification of all radio communication, and underscores that introducing microwave based AMS meters means forcing the population to expose itself to something classified as a possible carcinogen (cancer-causing substance) and a cause of EHS, which can involve both mental and physical disability:

> Ref. 94: Conrad, Richard H., Ph.D. Biochemist: Nine Reasons Why Today's Smart Meter Systems are a Mistake, by, May 9, 2014, https://bit.ly/3YWmiFx *
>
> "4) ADVERSE BIOLOGICAL EFFECTS OF MICROWAVE RADIATION
>
> Low level microwave radiation is not innocuous. Thousands of peer-reviewed research publications (BioInitiative 2012; January 16, 2014) show adverse biological effects from pulsed microwave frequency radiation at exposure levels well below FCC limits; often lower by orders of magnitude and in the range of emissions from smart meters. (For non-thermal biological effects, peak intensity is more important than averaged power. 24/7 exposure to smart meter pulses is actually an exposure of the same order of magnitude as using a cell phone for a much shorter time.) Studies have shown detrimental effects of low-level microwave exposure on animals, birds and bees. In animals: reduced fertility and sperm viability, disturbance of immune function, increased numbers of breaks in DNA, breaching of the blood-brain barrier making it more porous to toxins, increased oxidative stress, increased cancer rates and many other effects. See "Important letters from experts" in References and Notes section. In humans, alterations in brain waves, sleep patterns and heart rates; increased cancer rates. There would be much more known about health effects in humans but funds have been withdrawn for research on non-thermal effects, and non-thermal findings by the EPA have been kept under cover.
>
> 5) POSSIBLE HUMAN CARCINOGEN
>
> The World Health Organization's International Agency for Research on Cancer (IARC) has classified microwave radiation, specifically including that emitted by smart meters, as a **possible human carcinogen**. This means that in order to continue to receive electrical power, **people are being forced to live with a device on their homes that emits possibly carcinogenic microwaves 24/7**. The results of thousands of studies strongly suggest that microwaves are not safe for humans. At least with cell phones a person has a choice whether or not to use them. **If the smart meter roll-out plan had been submitted as a proposal for an experiment on human beings, which it undeniably is, any Institutional Review Board, including the division of the NIH that supervises such experiments on humans, would have rejected it outright.** Millions of persons world-wide are being used as guinea pigs without their permission. The smart meter roll-out violates Nuremberg principles."

* https://www.conradbiologic.com/articles/nine-reasons-why-todays-smart-meter-systems-are-a-mistake.html

> "7) MENTAL AND PHYSICAL DEBILITATION
>
> **Many people worldwide independently report becoming electrically sensitive for the first time in their lives after a smart meter was installed, and can no longer tolerate using cell phones or Wi-Fi. <u>It is important to note that in many of these cases, brand new and severe symptoms began to appear days or weeks BEFORE they learned that a smart meter was nearby</u>** (see Survey report). **Therefore effects on human functioning are a reality** and not paranoia or hysteria. Because of the severity of these symptoms, in many cases people are forced to abandon their homes if utilities [the network provider] refuse, as they sometimes do, to remove the smart meter."

In a letter aimed at politicians, Richard H. Conrad emphasises that the regulatory authority has stated that the exposure limits only protect against overheating and shock. It follows that the exposure limits do not protect against non-thermal effects that have been demonstrated in thousands of scientific research articles. Furthermore, he maintains that little scientific research is carried out in the civilian sector, and that most of this is carried out by the mobile phone industry itself.

Conrad draws the conclusion that from these bodies it is not reasonable to expect scientific research stating that such radiation is dangerous:

> Ref. 95: Conrad, Richard H., Ph.D.: For Legislators on Wireless Smart Meters: HEALTH and SAFETY ISSUES, May 12, 2014, https://bit.ly/3FTBg6o *
>
> "Thousands of research papers show significant non-thermal effects [4]. But the FCC (OET Bulletin 56) states that its MPE [Maximum Permissible Exposure, i.e. recommended maximum energy intensity values] protects only against "*recognized* hazards" (overheating and shock). Since non-thermal biological effects have not been officially recognized as being a hazard to humans by a U.S. Government agency, the FCC is essentially saying that their standards do not protect against non-thermal effects.
>
> The FCC goes on to say that: "relatively little civilian-sector RF research is currently being funded by the U.S. Government. At the present time, much of the non-military research. ... is being funded by industry organizations such as Motorola, Inc." In other words, none of the bodies doing research are likely to publicly release a verdict of "unsafe".
>
> Nine countries (including China, Russia and much of Europe) representing 40% of the world's population, have much lower exposure limits than the U.S.; some countries have established guidelines more than 100 times lower. Certainly China and Russia are not known to be overly protective of their populations."

In an expert testimony before the Public Utilities Commission of Maine, USA, Richard H Conrad tells how he discovered that AMS meters caused electro-hypersensitivity (EHS) in people: Being electrically hypersensitive himself, with an extensive background in biophysics and electronics, he received inquiries from people who suddenly could no longer tolerate using their own computer equipment etc. Gradually it became clear that in those cases, AMS meters had been installed shortly before – often without the affected being aware of it. He states that, disregarding a small group of people who seem to have nocebo effects, electro-hypersensitivity, or EHS, is demonstrated by all the usual requirements of good science: fully blinded experiments, careful observation, consistency and specificity, repeated strong and direct correlation between cause and effect and close correlation in time (page 5 et seq.):

* https://www.conradbiologic.com/articles/letter-for-legislators-on-wireless-smart-meters.html

> Ref. 96: Conrad, Richard H, Dr.: Maine Public Utilities Commission Testimony on Smart Meters. 2013, https://bit.ly/3I3DPWq [*]

The same Richard Conrad was, with Ed Friedman, behind an online survey of 210 self-recruited respondents who claimed to have had health reactions after the installation of an AMS meter. The aim of the investigation was to check whether these health problems could be causally related to the AMS meter installation or not. The sample is thus self-recruited, i.e. people who have chosen themselves to answer a questionnaire posted on websites for people concerned with EMF and AMS. As such, the selection method has its obviously weakness as based on self-recruitment, and the numbers of responses per questions are very varied. Hence, the answers must be interpreted in that light.

The analysis shows that 98% of the respondents believed their increased health problems were connected to the installation of AMS meters. Around 60% had good health and, as far as they were aware of, no EHS before the installation of the AMS meter, while far fewer were in good health a while after. *Almost half of them got their problems without knowing new meters had been installed*:

> Ref. 97: Conrad, Richard, PhD and Friedman, Ed: Smart Meter Health Effects Survey: Results, Analysis and Report, 2013, presented to the Maine PUC in their proceedings to determine the safety of smart meters: or https://bit.ly/3VtFSWL [†]

Ed Halteman worked on a survey with *The EMF Safety Network* yielding similar results, as respondents experienced the following problems:

> Ref. 98: Halteman, Ed, PhD: Report on Wireless Smart Meters showing the health effects, presentation, 2011, https://bit.ly/3ipeKLh [‡]

- sleep problems: 49%
- stress, anxiety, irritability: 43%
- headache: 40%
- ringing in the ears: 38%
- heart problems: 26%

In 2013, six doctors and a technologist conducted a review of the research literature and submitted a report to the water and electricity board in the city of Eugene, Oregon, USA:

> Ref. 99: Dart, Paul, M.D., (lead author), Kathleen Cordes, M.D., Andrew Elliott, N.D., James Knackstedt, M.D., Joseph Morgan, M.D., Pamela Wible, M.D., Steven Baker: Biological And Health Effects Of Microwave Radio Frequency Transmissions A Review Of The Research Literature – A Report To The Staff And Directors Of The Eugene Water And Electric Board, June 4, 2013, https://bit.ly/3jCDCPN [§]

In this report, they warn against both short-term and long-term health consequences from micro-wave communication from AMS meters. They further point out that the public exposure limits are only designed to protect against heating, and that:

> "a large body of scientific research documents that RF exposures at low levels may produce adverse biological or health effects."

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* https://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/01/Exhibit-9-Conrad-Web.pdf

† http://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/01/Exhibit-10-Smart-Meter-Health-Effects-Report-Survey2.pdf

‡ https://www.emfanalysis.com/wp-content/uploads/2015/08/emf-survey-on-smart-meters.pdf

§ https://apps.fcc.gov/els/GetAtt.html?id=171436&x

Furthermore, they refer to the typical symptoms picture for *microwave sickness*:

> "**EXECUTIVE SUMMARY**
>
> The FCC regulations for permissible exposures to microwave radio frequency (RF) transmissions are only designed to protect against the thermal effects of high exposure levels. Representatives of the telecommunications industry usually assert that there is "no clear or conclusive" scientific evidence regarding the biological effects of low level or "non-thermal" RF exposures. But in actuality, a large body of scientific research documents that RF exposures at low levels can produce adverse biological or health effects.
>
> ELECTROHYPERSENSITIVITY (EHS)
>
> Microwave RF exposures can produce acute symptoms in some individuals. These symptoms can include headache, sleep disturbance, difficulty in concentration, memory disturbance, fatigue, depression, irritability, dizziness, malaise, tinnitus, burning and flushed skin, digestive disturbance, tremor, and cardiac irregularities. This syndrome was described by Russian researchers in the 1950's, who called it "microwave sickness". Between 1953 and 1978 the Russian government purposefully targeted the U.S. embassy in Moscow with beams of microwave RF, producing symptoms of microwave sickness in many embassy employees."

Dr. De Kun Li, epidemiologist and senior researcher at Kaiser Permanente, has researched the effects of low-frequency voltages and health, and is also familiar with microwave research. He states in a report sent as a letter to the FCC (undated) that there are *no actual standards in the area, only some*

> "inadequate indicative calculation methods to avoid acute warming injuries" avoid acute heating damage"

and that these are insufficient to be used as a basis for calculating exposure limits, as it is currently done today:

> Ref. 100: De Kun Li: Letter from Dr. De-Kun Li, MD, PhD, MPH to the FCC on Smartmeters and the lack of public health protection, undated paper, https://ecfsapi.fcc.gov/file/7022311506.pdf [link broken as of 1.1.2023, however, similar statements from Dr. Li abound, e.g. here: https://bit.ly/3jA5t30] *

Furthermore, De Kun Li writes that the research base on which the FCC guidelines are based, is highly inadequate, that the guidelines do not take into account harmful effects that have been found to occur over time, and that so also applies to the properties of exposure and the levels to which one is exposed from smart meters:

In a 20-page expert opinion for the court from 2012, De Kun Li repeats the same as above: that the uncertainties are great. Furthermore, he maintains that it must be the manufacturer's, not the customer's, responsibility to demonstrate that the product is safe – as is the case with pharmaceuticals. There is no research that shows this, he writes, although research that definitely shows that it is harmful is also not available. On the other hand, there is research that gives indications that it is harmful:

> Ref. 101: De Kun Li, Dr., researcher at Kaiser Permanente: Pre-Filed Testimony Of De-Kun Li, MD, PhD, MPH, MPUC Docket No. 2011- 00262, pages 3 – 4 (our emphasis) https://ecfsapi.fcc.gov/file/7520940945.pdf [link broken as of 1.1.2023]:

* http://marylandsmartmeterawareness.org/wp-content/uploads/2014/08/DrDe-KunLi_letter.pdf

> “The science of understanding EMF health effects is still at an early stage. Like studying any other environmental risk factors, we will have to deal with the uncertainty of EMF safety for some time to come. Such uncertainty means that nobody can make a definitive statement about RF EMF health effect, whether safe or not safe. In other words, while nobody can make a final conclusion about RF EMF's adverse health effects, nobody can make a claim that RF EMF is safe either. Any such claim that RF EMF is safe is either ignorant or misleading.
>
> Given the uncertainty about RF EMF health effects, the question becomes whether it is the consumers’ responsibility to demonstrate the safety of a product by being exposed to it and becoming a victim or a casualty (e.g. brain cancer); or whether it is the responsibility of the producer of smart meters to demonstrate its safety before releasing it to the public. FDA requires pharmaceutical companies to demonstrate that a new medication is safe before it is allowed to be released onto the market. Medications usually have therapeutic value for patients and only those with certain conditions are exposed to them (affected size is really quite small for most medications). For a product like smart meters that almost everyone is exposed to, demonstrating its safety is the paramount responsibility of the producer.”

In France, the primary form of communication used between AMS meters is Power Line Communication (PLC), i.e. communication via the electricity network of the area. This technical solution produces *dirty electricity*.

There are several French verdicts that PLC from the AMS meters (in France named Linky) must be turned off for electrically sensitive people reacting to it. The following reference refers to to a case in court were 13 people won against the French state network provider:

> Ref. 102: The court of Tours requests the withdrawal of Linky meters from thirteen individuals for medical reasons, Franceinfo, 30/07/2019, https://bit.ly/3YPk7nj *

A plaintiff in a similar case as mentioned above, an EHS person in Grenoble, has had her meter removed through a court decision. Her “smart” *water meter* had worsened her symptoms. She received assistance from the departmental (i.e. county) Administrative Authority for Assistance to the Disabled, CDAPH (Commission des droits et de l'autonomie des personnes handicapées), to shield the home against electromagnetic fields by far below the public exposure limits (which are similar to the Norwegian ones):

> Ref. 103: “Electrosensible, son compteur retiré par décision de justice” (Electrosensitive, her meter removed by court order), 10 décembre 2016, https://bit.ly/3jDJOHr †

In a judgment of the Social Security Court (Tribunal du contentieux de l'incapacité) in Toulouse, France, in 2015, health reactions to exposures below the threshold values – i.e. EHS – was recognised as a disability:

> Ref. 104: “1re en France, l'électrosensibilité reconnue comme handicap” (First in France, electro-hypersensitivity recognized as handicap), https://bit.ly/3Q2TyqQ ‡

In the state of Iowa, USA, the court issued a ruling in 2018 which describes several elements parallel to the AMS meter roll-out in, e.g., Norway:

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* https://www.francetvinfo.fr/economie/linky/le-tribunal-de-tours-demande-leretrait-de-compteurs-linky-chez-treize-particuliers-pour-raisonsmedicales_3557845.html?fbclid=IwAR27mf6Gzcg1Rg4qTTyvp0C4cHV9UYy5npx1TZ26ppQ26qoIV5OO2ciIMt4

† https://informations.handicap.fr/art-electrosensible-justice-875-9369.php

‡ https://informations.handicap.fr/a-justice-reconnaissance-electrosensible-7956.php

Ref. 105: Iowa Final Ruling on Smartmeter Opt Out Against Interstate Power and Light 2018, https://bit.ly/3G4DOi6 *

Here is our summary of the judgment:

The case came to court after several hundred complaints against the area's electrical grid company (IPL) on the occasion of the introduction of an AMI – automatic meter infrastructure – with wireless meters for the company's approximately 500,000 meter points for electricity and 228,000 for gas. Certain private customer groups were given the opportunity to opt out of such meters, in return for a separate tariff (US$15/month) which should cover the grid company's additional costs connected with exemptions after new meters became the standard solution. The customers would have to read the meter themselves within a four-day period each month. The exemption program was designed to be just temporary. (pages 1-6)

Among the eight points of complaints were that the fee was unreasonable and that the meters exposed customers to unreasonable health risks (page 6). A significant number of customers wanted to keep the old analogue meters in order to limit electromagnetic pollution from radio waves and dirty electricity in the wiring network (called “conducted emissions” in the ruling, page 15).

Among the objections regarding health (page 33 onwards) were that the meters were often installed incorrectly, that safety distances could not be ensured the way the meters are installed, and that the manufacturer concealed or circumvented FCC requirements by calculating time averages of the radio radiation in a misleading manner. The network company's arguments were that the regulations were complied to with regard to exposure levels.

Among the objections regarding health were also (page 36 onwards) that the digital meters, whether with or without a radio transmitter, produce dirty electricity (transients) which can affect biological material as well as non-biological material. Against this, it was objected that FCC requirements were met – even though the FCC's requirements are not aimed at health protection, and, secondly, if dirty electricity is a problem, it may be removed with filters.

The Court found that:

- the exemption program's limitations were unacceptable.
- there was no reasonable reason to replace analogue meters to achieve higher reliability.
- the court was not the right body to decide whether the radio radiation was harmful to health or not,
- customers may remove dirty electricity from the meter with filters without unreasonable costs.

Among other measures, the ruling ordered the electricity network provider to 1) maintain exemptions as an option for all private customers with standard electricity subscriptions, and make the exemptions permanent, until further notice without any additional tariffs, 2) leave analogue meters with customers who wanted so, until the meters fail technically, 3) introduce as an option that the AMS meter only transmits radio signals once per month and is not included in any mesh network.

From the procedural documents in this case, we will also mention the following, which specifically deals with health effects from dirty electricity:

* https://ehtrust.org/wp-content/uploads/Final-ruling.pdf

> Ref. 106: Marcus, Jay B., Marcus Law Offices: BEFORE THE IOWA UTILITIES BOARD, INTERVENORS' POST-HEARING BRIEF, DOCKET NO: SPU-2018-0007, January 4, 2019, Fairfield, Iowa, USA: https://bit.ly/3GqnEBd *

In a consultancy study for the British information organisation *The EM Radiation Research Trust*, researcher and environmental designer Isaac A Jamieson in 2012 conducted a broad review of technical, health, environmental, safety, privacy-related, legal and other aspects of AMS meters for electricity and other supplies. He also reviewed possible alternative technical solutions for AMS meters which would not cause demonstrable health problems.

Jamieson's study contains a large number of references to scientific research sources which demonstrate health damage from exposure weaker than the current recommended exposure limits in the UK (which are identical to the Norwegian ones), as well as a large number of citations from various people's experiences with health problems after having AMS meters installed. His study also shows how the international investments in AMS meters are organised, and entities participating:

> Ref. 107: Jamieson, Isaac A, PhD DIC RIBA DipAAS BSc (Hons) MInstPS: SMART METERS – SMARTER PRACTICES, Revision 1, January 2012 EM-Radiation Research Trust, 279 p, https://bit.ly/3WA1VfY †

Which symptoms are the most frequently observed after installing AMS meters? Symptoms that were most frequently reported to occur after the installation of smart meters were mapped in an Australian study in 2014. This study looked at 92 residents who reported symptoms to a website, analysing and discussing them. The most frequent were *insomnia, headache, tinnitus, fatigue, cognitive disturbances, dysaesthesia* (abnormal sensation, possibly chronic pain, triggered by the central nervous system), dizziness:

> Ref. 108: Lamech F.: Self-Reporting of Symptom Development From Exposure to Radiofrequency Fields of Wireless Smart Meters in Victoria, Australia: A Case Series, Altern Ther Health Med. 2014 Nov-Dec;20(6):28-39. http://www.ncbi.nlm.nih.gov/pubmed/25478801

We see that these symptoms are roughly identical to the ones found in all investigations of acute effects from AMS meters. They also form part of the microwave syndrome, discussed previously.

Scientific researcher Andrew Marino, a physicist and lawyer, testified in 2016 before the Pennsylvania Utility Commission. He undertook a comprehensive review of bioelectricity, its impact in general and as to AMS meters in particular. Included is a review on how scientific research on electro-hypersensitivity has found this to be *a neurological condition*, and falsified that it is only the question of a nocebo effect. Marino underscored, inter alia, the following (pages 1-2. See also the comprehensive review pp. 17-26):

> Ref. 109: Marino, Andrew A: Expert Report of Andrew A Marino, August 8, 2016 Povacz v PECO, Pennsylvania Utility Commission, 2017 (Marino 2016), https://bit.ly/3Q7a1dy ‡
>
> "Scientific evidence indicates that the neurological syndrome of electromagnetic hypersensitivity exists. There is a reasonable basis to believe that the symptomatology of the Complainants and its relation to smart-meter electromagnetic energy is factual."

We also cite from Marino (Ref. 109):

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* https://ehtrust.org/wp-content/uploads/Lipman-Matara-Post-Hearing-Brief-PUBLIC.pdf

† https://einarflydal.com/wp-content/uploads/2019/12/Jamieson-Smart-meters-smarter-practices-0120130.pdf

‡ https://www.andrewamarino.com/PDFs/F277-Povacz_v_PECO2017.pdf

(Page 4) “Electromagnetic energy occurs naturally in the environment, for example, the earth’s magnetic field, and has a profound influence on all basic biological phenomena including growth regulation and control, circadian rhythms, and spatial orientation. Since the beginning of the twentieth century, and particularly after the end of World War II, the levels of man-made electromagnetic energy occurring in the general and work-place environments have risen dramatically as a result of man’s economic and social activities.” … [such as] … “telegraph, radio, television, radar, powerlines, cell phones, wireless networks, smart meters, and innumerable other similar examples.”

(Page 12) **Health Risks Due to man-made Environmental Electromagnetic energy**
Q: When you said that there is a basis in established science for serious concern regarding risks to human health caused by man-made electromagnetic energy in the environment, what did you mean by “established science.”

A. I meant the two types of peer-reviewed publications that are the primary repository of our scientific knowledge about living systems including, of course, knowledge about the effects of electromagnetic energy on living things. The two types are experimental studies and epidemiological studies.

(Pages 15 – 16) Q: Why do you conclude that there is a basis in established science for serious concern regarding risks to human health caused by man-made electromagnetic energy in the environment, including the type of electromagnetic energy emitted by smart meters?

A: Because both methods in experimental biology for assessing whether a factor or condition is a possible health risk, namely experimental studies and epidemiological studies, individually and together, indicate that man-made environmental electromagnetic energy is a health risk. Numerous peer-reviewed scientific studies in experimental biology involving the effects of man-made electromagnetic energy, including the type produced by smart meters, have shown that such energy causes a wide range of biological effects on the endocrinological, immunological, cardiovascular, hematological and neural systems of the body, and on growth and healing. The results of these studies are the best evidence obtainable by means of the scientific method regarding the possible existence of health risks to humans. Consequently these studies directly support the conclusion that exposure to man-made electromagnetic energy is a health risk to humans. In addition, many independent epidemiological studies indicate that man-made environmental electromagnetic energy is associated with a broad range of human diseases and disorders, especially cancer. It is difficult for me to imagine what further evidence would be needed to establish that there is a basis in established science for serious concern regarding risks to human health caused by man-made electromagnetic energy in the environment, including the type of electromagnetic energy emitted by smart meters.”

As earlier mentioned, Martin L. Pall, basic medicine physician and geneticist, became world famous, together with two other scientists, around 2006 for launching a general explanation to a number of “MUS” (in Norwegian: MUPS), i.e. medically unexplained symptoms, discussed elsewhere in this book. The explanation is based on *environmental contaminants* (or *environmental stressors*) causing *calcium influx at the cell level*, in turn causing *oxidative stress*. In 2013, Pall included EMF in the model, and has since become world-renowned for his many studies and lectures on EMF effects through the same explanatory model.

In an expert testimony before the Massachusetts Senate, Pall emphasized that there is a large amount of general research on the health effects of electromagnetic fields that is relevant to AMS

meters, showing health effects reported as effects from AMS meters. Here are some excerpts from the transcript of Pall's testimony:

> Ref. 110: Martin Pall, Prof. em.: Testimony given during a hearing on Massachusetts Senate Bill 1864: No Fee Opt Out for Smart Meters. June, 20, 2017, shortlink: https://bit.ly/3GqxW4j *
>
> "There're many different health effects that have been extensively documented as being caused by EMFs. Most of them have never been looked at with smart meters, but three of them have been, and they've all been reported to be occurring at very substantial levels in response to smart meters. *And those are: that there're widespread neuropsychiatric effects; there are cardiac effects on the electrical control of the heart – those are life-threatening because the arrhythmias that occur can be, are often associated with sudden cardiac death; and then finally, there's electromagnetic hypersensitivity, which has just been referred to.*[2] *Those three have all been reported to occur in response to smart meters."*

Also, Pall stresses that these meters are deployed without any kind of prior testing for biological effects. On the contrary, it is done on the basis of exposure limits which since the 1950s have repeatedly been shown *not* to provide protection against such radiation:

> "Now the smart meters were put out, as are all wireless communication devices, without any biological testing whatsoever, safety testing whatsoever. The guarantees of safety that the industry has put forth is based on an assumption that only thermal, that is, only heating effects can occur. And there's been data from thousands of studies, going all the way back to the 1950s that that's not true, OK, that there are many non-thermal* effects, including the three that I just talked about. So, I think there should be no question that smart meters have biological effects."
> [Addition made in the transcript of the testimony: "*[non-thermal = not x-ray, non-ionizing, no heating]"]

Pall concludes his testimony by mentioning that strongly pulsed radiation, such as from AMS meters, has a significantly greater biological impact than non-pulsed radio frequency fields:

> "Now there're some other issues here that are important. One is that pulsed fields – fields that pulse up and down – are much more biologically active in most cases than non-pulsed fields, or continuous wave fields. Smart meters are highly pulsed, and therefore they are problematic for that reason, as well.
>
> And, so, and let me just say, everything I say here will be denied by industry, I guarantee it.
>
> This [which I have presented] is what the science says. Thank you."

Technical calculations as to radiation from AMS meters, compared to the US exposure limits (which are very similar to the Norwegian ones), have been made by Sage Associates, Santa Barbara, California, a company specialised in EMF issues and heavily involved in *The BioInitiative Report*:

> Ref. 111: Sage Environmental Consultants: Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters, Sage Associates, Santa Barbara, CA, USA, January 1, 2011, 100 p, https://bit.ly/3PZNCyA †

Sage Associates finds in model calculations that the exposure limits are exceeded in a number of realistic and practical scenarios (pp. 3-4):

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* https://ehtrust.org/wp-content/uploads/F0A37E38-356D-42BB-86F3-1E6C50CABE83.pdf

† http://sagereports.com/smart-meter-rf/docs/Smart-Meter_Report.B-Tables.pdf

> "RF levels from the various scenarios depicting normal installation and operation, and possible FCC violations have been determined based on both time-averaged and peak power limits (Tables 1 – 14).
>
> Potential violations of current FCC public safety standards for smart meters and/or collector meters in the manner installed and operated in California are predicted in this Report, based on computer modeling (Tables 10 – 17).
>
> Tables 1 – 17 show power density data and possible conditions of violation of the FCC public safety limits, and Tables 18 – 33 show comparisons to health studies reporting adverse health impacts.
>
> It is likely that violations of FCC rules will occur under normal conditions during the installation and operation of smart meters and data collection meters in California.
>
> FCC compliance violations are likely to occur under normal conditions of installation and operation of smart meters and collector meters in California. Violations of FCC safety limits for uncontrolled public access are identified at distances within 6" of the meter [i.e. approx. 15 cm.] Exposure to the face is possible at this distance, in violation of the time-weighted average safety limits (Tables 10-11). FCC violations are predicted to occur at 60% reflection (OET Equation 10 and 100 % reflection (OET Equation 6) factors*, both used in FCC OET 65 formulas for such calculations for time-weighted average limits. Peak power limits are not violated at the 6" distance (looking at the meter) but can be at 3" [5 cm] from the meter, if it is touched.
>
> This report has also assessed the potential for FCC violations based on two examples of RF exposures in a typical residence. RF levels have been calculated at distances of 11" [28 cm] (to represent a nursery or bedroom with a crib or bed against a wall opposite one or more meters); and at 28" (to represent a kitchen work space with one or more meters installed on the kitchen wall).
>
> FCC compliance violations are identified at 11" in a nursery or bedroom setting using Equation 10* of the FCC OET 65 regulations (Tables 12-13). These violations are predicted to occur where there are multiple smart meters, or one collector meter, or one collector meter mounted together with several smart meters."

Such studies – whether done on models or under realistic conditions – have, as far as we know, not been done for the meters installed in Norway or elsewhere. It is conceivable that similar results would be obtained, for example, since fuse boxes are often located in the wall between a bedroom and the entrance hall, or in the entrance hall, where one might stand in the *near field* of the transmitting antenna, where exposure levels for physical reasons are significantly higher than in the far field, where measurements are done. Near fields are discussed elsewhere in this book.

The report from Sage Associates also points out that a main purpose of AMS meters is to use them in the future for control functions within the home. They are intended to spur a development where household items are increasingly equipped with transmitters and receivers (p. 11):

> "In order for smart meters to monitor and control energy usage via this wireless communication system, the consumer must be willing to install power transmitters inside the home. This is the third part of the system and involves placing power transmitters (radiofrequency / microwave radiation emitting devices) within the home on each appliance. A power transmitter is required to measure the energy use of individual appliances (e.g., washing machines, clothes dryers, dishwashers, etc.) and it will send information via wireless radiofrequency signal back to the smart meter. Each power transmitter handles a

> separate appliance. A typical kitchen and laundry may have a dozen power transmitters in total. If power transmitters are not installed by the homeowner, or otherwise mandated on consumers via federal legislation requiring all new appliances to have power transmitters built into them, then there may be little or no energy reporting nor energy savings.
>
> Smart meters could also be installed that would operate by wired, rather than wireless means. Shielded cable, such as is available for cable modem (wired internet connection) could connect smart meters to utilities. However, it is not easy to see the solution to transmit signals from power transmitters (energy use for each appliance) back to the utility."

The report from Sage Associates raises, by extension, the topic of the AMS meter as a communication and control centre for automatic functions in the home, as well as questions about how it would be possible to pre-approve the health aspects of such a solution that has an unknown number of transmitters connected to it. (Page 18).

Occupational hygienist and measurement technology specialist Peter H Sierck has demonstrated that the sharp pulses from AMS meters are very difficult to measure: Different measuring instruments will register very different frequencies and strengths. This is because the measuring devices do not measure continuously, but only by sampling, and the pulses are very short, usually only 12 milliseconds. With the wrong measuring equipment, only parts of the pulsing is captured:

The less frequently the measuring devices log, the lower the pulse rate will therefore be recorded. The pulses might also be too strong for the measuring devices to measure the strength: Such errors might cause measurements to be too favourable.

> Ref. 112: Sierck, Peter H., Industrial Hygienist: Smart Meter – What We Know, Measurement Challenges and Complexities, A Technical Paper to Clarify RF Radiation Emissions and Measurement Methodologies, EMF&RF solutions, Environmental Testing & Technology, Inc (ET&T), California, December 2011, https://bit.ly/3FTLLa0 *

In line with Sierck's findings, the Norwegian consultancy company EMF Consult AS has criticised the Norwegian Communications Authority (NKOM) for capturing a far too low number of pulses from AMS meters in their AMS meter measurement report (of January 2018) – only 25% of the correct number. Suspicion was the Authority was using an unsuitable measuring device, which would lead to precisely such errors:

> Ref. 113: email 8.8.2018 from EMF Consult AS to NKOM. For a blog post with the relevant links and reviews: https://bit.ly/3i029Ok †

The four times higher pulse frequencies found by EMF Consult's measurements on the identical brand AMS meters after rolled out, remains uncontested, and the discrepancy remains unresolved. As NKOM's tests were done with early versions of the AMS meter software versions, this provides a possible, untested explanation.

The Norwegian RPA, DSA, has claimed on several occasions that it may not be necessary to carry out more measurements, as the meters emit radiation at intensities far below the exposure limits anyway. Accordingly, Norwegian government authorities have not produced nor commissioned any AMS meters exposure tests since January 2018.

EMF Consult AS also stated that the Norwegian National Radiation Protection Authority (DSA) claim the transmission intensity from AMS meters to be much weaker than mobile phones, was

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* https://einarflydal.com/wp-content/uploads/2021/01/SmartMeter-Smart-Meter-What-We-Know-2011-Sierck.pdf

† https://einarflydal.com/2018/09/04/smartmalere-nye-alvorlige-feil-funnet-i-nkoms-malerapport/

made on false grounds: DSA was mixing up two different measurement methods (e.r.p. versus e.i.r.p.).

The Norwegian National Radiation Protection Authority (DSA) thus based its fact sheet about AMS meters on incorrect information (documents in Norwegian only), even after a slight modification:

> Ref. 114: The Norwegian Radiation Protection Authority: “Weak radiation from smart electricity meters”, Strålevernинfo 09 17, 2 p., 21.08.2017,
> original version: https://bit.ly/3Q1Czov;* retouched version: https://bit.ly/3jDVgCR†

DSA’s claims of no risk and of radiation being so weak, and of no possible health effects from AMS meters, have been, and still are, echoed by the industry over and over again. Based on the reviewed material, we see that these claims are not well founded. This is further substantiated in later parts of this book.

2.13.1 Some other topics from expert testimonies

In addition to health and environmental impacts, design, choice of materials and dirty electricity may affect the reliability of the meters. This emerges from some expert assessments and is mentioned here. These topics are not discussed further in this book.

Poor design and lacking specifications may prevent smart meters from working, or greatly reduce their registration accuracy (and thus increase bills), e.g. under extremely low temperatures. Jamieson investigates this in the following note:

> Ref. 115: Jamieson, Isaac A: Smart Meters and Weather Extremes – Set to Fail? – What happens when weather is colder than smart meters can operate?, paper, undated, https://bit.ly/3i2vuaY ‡

Dirty electricity from energy-saving bulbs, LEDs and dimmers in particular may lead to large deviations in the meter readings. This is demonstrated in:

> Ref. 116: Leferink, Frank, Cees Keyer, Anton Melentjev: Static Energy Meter Errors Caused by Conducted Electromagnetic Interference, IEEE Electromagnetic Compatibility Magazine – Volume 5 – Quarter 4, 2016, featured in “Strømmålere viser grove feil i nederlandsk forskningsrapport Opptil 582 prosent avvik på smarte strømmålere” (Electricity meters show gross errors in Dutch research report: Up to 582 percent deviation on smart electricity meters), Din Side, 2016, https://bit.ly/3WLll0M §

2.13.2 Template for holding network companies’ CEOs accountable

Below you will find a template for warning the top manager of a local grid company of personal liability for harmful effects, etc. as a result of installing an AMS meter.

This document is included here for the following reason: In environments opposed to switching to AMS meters, efforts have been made to adapt this document to Norwegian law. After consultation

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* https://einarflydal.com/wp-content/uploads/2018/06/StraaleverninfoORIGINAL-09-2017-smarte-stroemmaalere.pdf

† https://einarflydal.com/wp-content/uploads/2018/06/StraaleverninfoRETTET-09-2017-smarte-stroemmaalere-ny-versjon.pdf

‡ http://stopsmartmeters.org.uk/wp-content/uploads/2012/09/Jamieson-I.-Smart-Meters-Weather-Extremes-1-Sep-2012.pdf

§ https://einarflydal.com/wp-content/uploads/2019/12/Str%C3%B8mm%C3%A5lere-viser-grove-feil-i-nederlandsk-forskningsrapport-Opptil-582-prosent-avvik-p%C3%A5-smarte-str%C3%B8mm%C3%A5lere-DinSide.pdf

with legal expertise, we have come to the conclusion that it is not suitable, due to different legal traditions. Such personal liability claims may work better within the British legal tradition (UK, USA and the British Commonwealth) than in a law system where claims must be based on material loss:

> Ref. 117: Notice of Liability template, https://www.emfhelpcenter.com/downloaddocs/NoticeOfLiability.doc

2.13.3 Some relevant expert investigations discussed elsewhere in this book

The following study compares exposure levels found to cause adverse effects with exposure levels predicted from wireless AMS meters:

> Ref. 118: Powell, Ronald M., physicist, Ph.D.: Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances, June 11, 2013, https://bit.ly/3C4wP7V *

Powell's study is commented in:

> Ref. 119: Flydal, E: Smart about “smart meters” and health damage, 25/01/2016, https://bit.ly/3PXxait†

The following comprehensive study by Powell ranks various AMS meters according to various technical aspects and how they relate to health, privacy, social security etc.:

> Ref. 120: Powell, Ronald M., physicist, Ph.D.: Ranking Electricity Meters for Risk to Health, Privacy, and Cyber Security, November 12, 2015 Edition 3, https://bit.ly/3I9JrOH,‡ discussed here (Norwegian): https://bit.ly/3i0cNVi §

2.14 Near the transmitters, the radiation is far stronger, but not measured

Radio transmitters have a *near field* and a *far field*. When measuring exposure from radio transmitters, one must measure at a certain distance from the transmitter. Too close to the transmitter, in what is called *the near field*, particular physical conditions apply which make measurements very unreliable and too low. In the near field, you simply do not know the exposure.

Professional electronics engineer Jostein Ravndal emphasizes that there is such a significant *near-field zone around any fuse box.* Here, measurements cannot be carried out with any reasonable degree of reliability:

> Ref. 121: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3**, Part 2, section3.2.

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* https://skyvisionsolutions.files.wordpress.com/2013/06/powell-report-bioinitiative-report-2012-applied-to-smart-meters-and-smart-appliances_june_11_2013.pdf

† https://einarflydal.com/2016/01/25/smart-om-smarte-malere-og-helseskader/

‡ https://einarflydal.com/wp-content/uploads/2019/12/Ronald-Powell-289782183-Ranking-Electricity-Meters-for-Risk-to-Health-Privacy-and-Cyber-Security.pdf

§ https://einarflydal.com/2020/12/22/ams-malernehelse-personvern-og-nettsikkerhetsrisikoen-og-skitten-strom/

** Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

"You have to measure – and calculate – the exposure at the right distance, 2 to 3 wavelengths from the antenna. Thus, the distance at where to measure therefore depends on the frequency being measured and is therefore longer for the Kamstrup meters (2 m) than for Aidon and Nuri (0.9 m), as the latter two transmit at a higher [carrier wave] frequency.

This fact may offer surprises: Within these minimum distances, both measurements and theoretical calculations become very unreliable. This is so because the radiation in the near field behaves quite differently than in the far field. In practice, the exposure in the near field cannot be calculated, nor measured. The only thing that can be said about the exposure in the near field, is that it probably gets more intense the closer you get to the source, perhaps significantly more intense than the four times each time distance is halved, which is the thumb rule for the far field.

There is therefore considerable uncertainty about what the real [exposure] values are for the nearest bed pillow [in the example described]: The exposure is probably greater than calculated because the bed pillow is in the near field.

In the corridor/hallway of the same house ([figure 18 in the source]) we see that large parts of the hallway in the house are within the near field. Hence, it is uncertain what the exposure there might be. Exposures of 16,000 to 81,000 μW/m^2 or higher are calculated at distances of 0.9 and 2 metres respectively."

In many homes, you are probably standing within such distances from the meter when you stand by the front door and talk with your neighbour. You are then standing in the near field, and cannot know what the real exposure is where you are standing, even not if you are measuring with a microwave intensity meter.

See picture, Figure 10: The fuse box with the AMS meter is to the left: the metal closet with the mirror. What is then a reasonable safety distance to the AMS meter, when, as in the case of the most frequently installed meter brands in Norway, the near field extends to a 0.9 to 2 m distance away from the meter?

You may also be in the near field if you are on the other side of the wall, for example in your bed, in a sofa or a chair next to the wall.

The possibility that such metal cabinets may act as a transmitting antenna, have never, as far as we know, been assessed during the introduction of AMS meters. Nor have the meters or the cabinets been equipped with warnings as to safety distances. This also applies in cases where an extra antenna is mounted on the outside of the fuse box, which is frequently done.

Figure 10: Chatting with the neighbour at the front door – with her head in the near field.

As shown in Figure 10, situations may occur where the head or entire body is frequently located next to the fuse and meter cabinet.

In a number of subpoenas about exposure from mobile phones held to the head, it has been demonstrated that the thermal-based exposure limits are exceeded. The demands have been that these models should be withdrawn from the market, and several models have so, or updated with software restricting their radiation intensity.

> Ref. 122: Alerte Phonegate: 60 plaintiffs file class action against Xiaomi, press release, 20.07.2020, https://bit.ly/3i5K3dD *

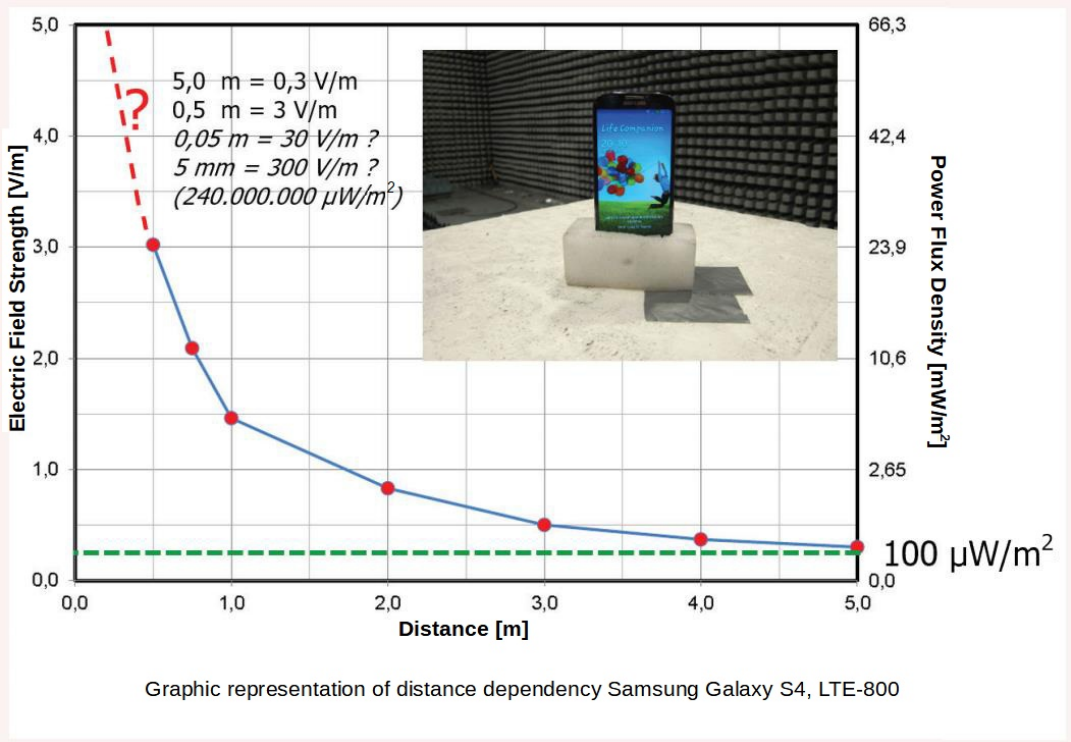

Figure 11: Exposure levels for a Samsung Galaxy S4 at different distances, but very uncertain in the near field (smaller than for AMS meters' lower frequencies)

A German investigation demonstrates the uncertainty of the measurements – and of staying – in the near field related to exposure strength from a modern mobile phone (Samsung Galaxy S4) at maximum transmission strength over 4G (LTE 800). See Figure 11. Vertical axes show the intensity of the radiation, measured left side as Volts per meter (V/m) and right side as milliwatts per square meter (mW/m^2), while the horizontal axis shows distance in meters.

> Ref. 123: Kühling, Wilfried: 5G/Mobilfunk durch gesamträumliche Planung steuern, Kompetenzinitiative (Controlling 5G/mobile communications through overall spatial planning), Kompetenz Initiative, 2021, p. 011, https://bit.ly/3vmvg1p†

Figure 11 suggests that in the case of a Samsung Galaxy S4 mobile phone, at a short distance, i.e. in the near field, e.g. 25 cm, the exposure level may be 3 V/m, which corresponds to around 23,900,000 µW/m^2. As a reference, the green, dashed line in Figure 11 shows EUROPAEM's

* https://www.phonegatealert.org/en/press-release-phonegate-60-plaintiffs-file-class-action-against-xiaomi

† https://kompetenzinitiative.com/wp-content/uploads/2021/01/Magazin_final_web.pdf

precaution-based recommended maximum exposure in living areas, 100 $\mu W/m^2$. (More on EUROPAEM's guidelines follow later.)

AMS meters have a maximum transmission power of 3-4 times that of a modern mobile phone.

2.15 Misconduct by government bodies and the industry

In this section, examples are given that demonstrate how governmental bodies and industry ignore significant non-thermal effects found and documented by scientific research. Instead, they stick to the reference values given in the guidelines from IEEE/FCC/ICNIRP, which are set to avoid damage only from tissue heating in humans, explicitly leaving other possible effects to national bodies to consider.

By linking the danger connected to "non-ionizing" radiation to its heating capacity, such radiation is "acquitted", since it is – under circumstances normally met by the general public – kept negligibly low when measured in accordance with the IEEE/ICNIRP/FCC guidelines. The measurement method focuses on heating effects as an average over time (6 or 30 minutes), which means short peaks might be of much higher energy intensity. Other biological effects outside the scope of these guidelines, but demonstrated empirically in various scientific studies to be highly relevant to health and damage to the environment, include a plethora of effects connected to terms such as *signal modulation, intermittent radiation, pulsation, constructive interference* from several radiating sources, *dirty electricity,* and signals' *information value*.

For a more general discussion of research findings, see discussions elsewhere in this book. The general policy of leaving out non-thermal effects from the ICNIRP guidelines and all literature reviews done according to ICNIRP guidelines, leaving such effects to national governmental or other bodies to evaluate, is written into the ICNIRP policy statement formulated as

> Ref. 123b: ICNIRP Statement, General Approach to Protection Against Non-Ionizing Radiation Protection, Health Physics 82(4):540-548; 2002

This policy document states that *ICNIRP is only concerned about risks which are quantifiable and related to energy intensity thresholds, while other effects not proven to be connected to an energy intensity threshold* (by ICNIRP's criteria for proofs), *are considered "subject to social and economic considerations"*, i.e. political, and the realm of national governmental bodies (p. 545, 1st column):

> "If available data permit the identification of an adverse effect, but not the detection of a threshold, other risk reducing strategies may be employed. The role of ICNIRP as a scientific advisory body would be to analyze the risk in terms of levels of consequences that could be quantified. The acceptability of such risks would, however, be based also on social and economic considerations, and, as such, fall outside the remit of ICNIRP. National authorities responsible for risk management may provide further advice on strategies to avoid the effect or limit the risk."

Thus, many national bodies have provided further restrictions, e.g. as to the use of WiFi in kindergartens. However, others – governmental bodies and industry alike – have not, and defend the use of the thermally based reference values as all that is needed.

The following report from Tarditi is mentioned here as a typical example: It relates to the IEEE/ICNIRP guidelines to protect against thermal risks, and assesses the exposure based only on these guidelines' recommendations. In this report, such a basis for risk assessment is not considered problematic:

Ref. 124: Tarditi, Alfonso G., Electric Power Research Institute (EPRI): Smart Metering Issues, 52nd Annual Rural Energy Conference February 12-14, 2014, La Crosse (WI), foils, https://bit.ly/3Gs9srf *

In this report it is argued by comparing how insignificant the exposure from an AMS meter at a distance of one metre is, compared to the exposure from a mobile phone held to the ear. The argument is based on measurements of the heating potential, i.e. the energy intensity averaged over time. In such calculations, the radiation from the AMS meter will necessarily seem trivial. However, such measurements are unrealistic for a number of reasons, among others as they only measure one source at a time. Still, such measurements are used to underpin the roll out of AMS meters:

Ref. 125: California Council on Science and Technology (CCST): Health Impacts Of Radio Frequency From Smart Meters, 2011, https://bit.ly/3WU8vO4 †:

"CCST found that, given the body of existing, generally accepted scientific knowledge regarding smart meters and similar electronic devices, the FCC standard provides an adequate factor of safety against known RF induced health impacts of smart meters and other electronic devices in the same range of RF emissions. At this time, there is no clear evidence that additional standards are needed to protect the public from smart meters or other common household electronic devices."

The investigation made by CCST was countered by Magda Havas, MD, PhD, Trent University, Canada – by invitation from CCST, but then not published:

Ref. 126: Magda Havas: Havas Submission to CCST "Report on Smart Meters", 2011, https://bit.ly/3YXb6IP ‡

Also, it has been demonstrated that the calculations of the exposure intensity in the same report from CCST are grossly misleading:

Ref. 127: Daniel Hirsch: Comments on the Draft Report by the California Council on Science and Technology "Health Impacts of Radio Frequency from Smart Meters", 31 January 2011, https://bit.ly/3WVOrdV §

The GSM Association (GSMA) is a worldwide trade organisation for business players in mobile communications. The GSMA publishes information material, works politically and lobbies, holds major conferences and shows, and cooperates with UN bodies to promote the industry's interests. In 2015, the GSMA published an information booklet on AMS meters:

Ref. 128: GSMA, 2015, "Smart meters: Compliance with radio frequency exposure standards", GSMA, 2015, https://bit.ly/3Cb2hkG **

The same type of criticism can be raised against GSMA's information booklet as against the CCST investigation: The GSMA brochure argues based on assessment criteria that do not capture significant parameters that have been proven to be harmful. It argues by referring to various bodies which, based on energy intensity and tissue heating over time as assessment criteria, have of course found that the radiation cannot possibly be harmful to health, as it does not exceed the recommended

* https://einarflydal.com/wp-content/uploads/2019/12/EPRI-2014-SmartMeteringIssues.Tarditi.pdf

† https://ccst.us/reports/health-impacts-of-radio-frequency-from-smart-meters/

‡ https://www.magdahavas.com/wp-content/uploads/2011/01/Havas-Report-CCST-Smart-Meters.pdf

§ https://ccst.us/wp-content/uploads/letter8hirsch.pdf

** https://www.gsma.com/publicpolicy/wpcontent/uploads/2015/06/gsma_smart-meters_2015.pdf

exposure limits – set to protect only against acute heating damage. For a critique of the GSMA booklet see (Norwegian only):

> Ref. 129: Flydal, E: “Smart meters: the health premise that disappeared”, blog post 16/11/2017, https://bit.ly/3GrWRV6 *

Norwegian health authorities have chosen to follow the Norwegian RPA, which follows the ICNIRP guidelines by “being more catholic than the pope”: The Norwegian RPA bases its view on literature reviews which in their assessments reject all research suggesting harmful effects other than acute heating injuries. Based on the NRPA's own statement in the form of a letter (see Figure 12), this policy is based on the NRPA’s own organisation not having the necessary competence for doing any such assessments itself:

> Ref. 130: Letter from the Norwegian Radiation Protection Authority [then Strålevernet, now DSA] to law firm Steenstrup Stordrange DA, 29/04/2015, ref. 15/00224/301 regarding the competence of the Norwegian Radiation Protection Agency to evaluate scientific research within this field, https://bit.ly/3vr86qx † (English translation in Figure 12)
>
> “As stated in our letter of 20th of March 2015, the Norwegian Radiation Protection Authority's management within this field is based on ICNIRP's recommendations. It is not so that individual employees at the Radiation Protection Authority assess whether exposure to EMF has health effects or not. Hence, the state of knowledge is assessed by ICNIRP and other expert groups.”

This lack of own competence, which seems to include the ability or willingness to read the ICNIRP 2002 policy document mentioned above, results in a politically based obligation to reject all research and all research environments identifying non-thermal effects, and comprises even the claim that there is “no professional disagreement about the radiation”.

This position is repeated in a long series of statements, where the Radiation Protection Authority (DSA) and other governmental bodies refer to exposure limits for protection against acute heating damage, in order to legitimize that there should be no other health risk associated with the AMS meters. They thereby defend a view of the state of knowledge which is only true if one rejects most of the research, including well-documented findings of harmful effects:

> Ref. 131: “No professional disagreement about the radiation”, newspaper interview with senior adviser Lars Klæboe, DSA, in Varden ca 16.06.2019. JPG, https://bit.ly/3Qi5AwF ‡
>
> “There is no disagreement among the professionals within this field. They agree that the radiation from the new smart electricity meters is weak – only thousandths of the limit value.
>
> This means that it is not important whether the radiation from the electricity meters is higher or lower than from mobile and wireless networks.
>
> It is also important to point out that the research does not provide evidence to claim that radiation from electricity meters, mobile phones or wireless networks leads to health issues and diseases.”

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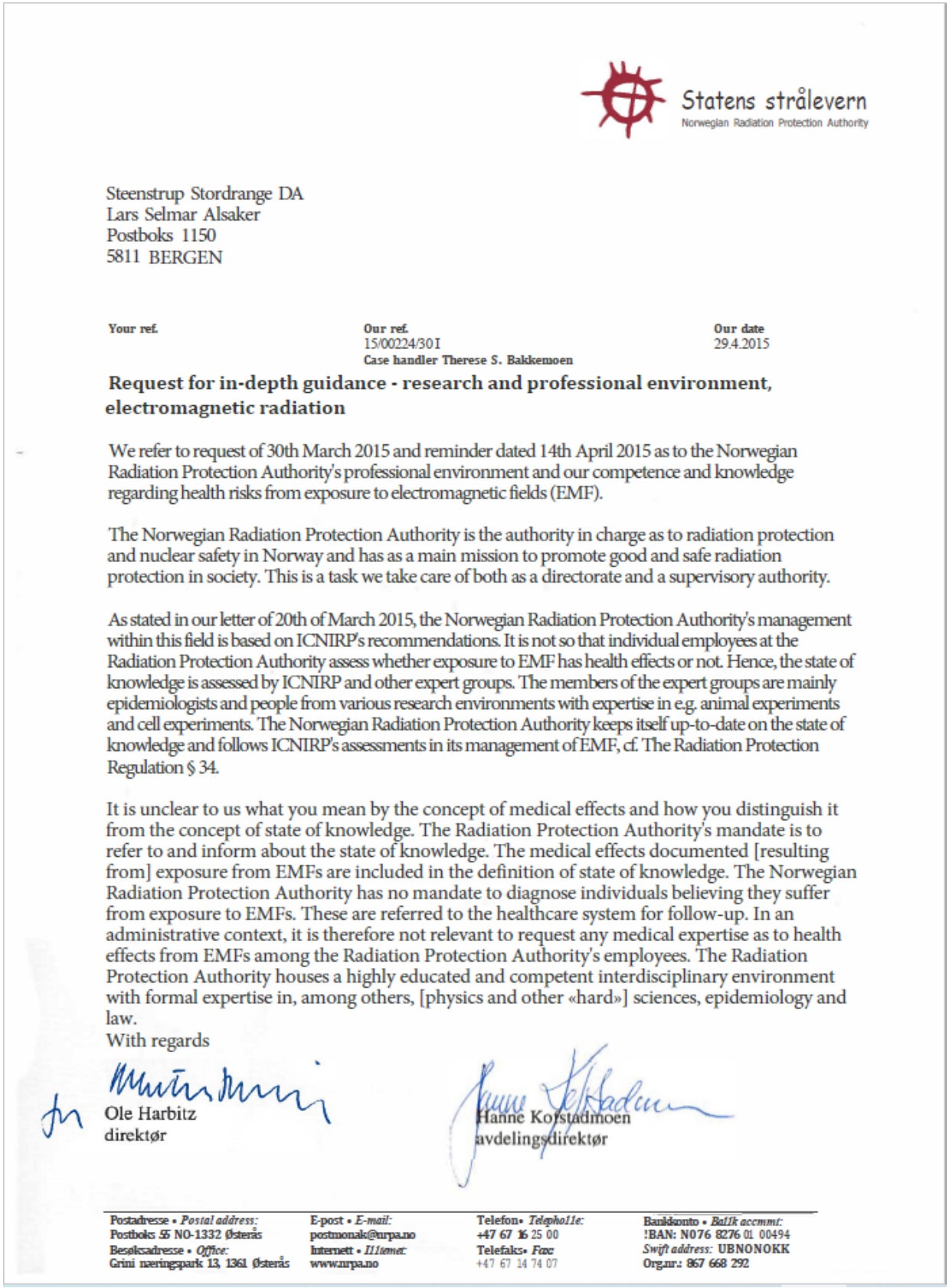
* “Smartmålerne: helsepremisset som forsvant” (Norwegian), https://einarflydal.com/2017/11/16/smartmalerne-helsepremisset-som-forsvant/

† https://einarflydal.com/wp-content/uploads/2022/12/svar-fra-SS-til-Alsaker-Stordrange-20032015.pdf

‡ “Ikke faglig uenighet om strålingen” (Norwegian), https://einarflydal.com/wp-content/uploads/2019/12/Klæboe-Varden-22.03.2016-Ikke-faglig-uenighet-om-strålingen.jpg



Statens strålevern
Norwegian Radiation Protection Authority

Steenstrup Stordrange DA
Lars Selmar Alsaker
Postboks 1150
5811 BERGEN

Your ref.	Our ref.	Our date
	15/00224/30 I	29.4.2015
	Case handler Therese S. Bakkemoen	

Request for in-depth guidance - research and professional environment, electromagnetic radiation

We refer to request of 30th March 2015 and reminder dated 14th April 2015 as to the Norwegian Radiation Protection Authority's professional environment and our competence and knowledge regarding health risks from exposure to electromagnetic fields (EMF).

The Norwegian Radiation Protection Authority is the authority in charge as to radiation protection and nuclear safety in Norway and has as a main mission to promote good and safe radiation protection in society. This is a task we take care of both as a directorate and a supervisory authority.

As stated in our letter of 20th of March 2015, the Norwegian Radiation Protection Authority's management within this field is based on ICNIRP's recommendations. It is not so that individual employees at the Radiation Protection Authority assess whether exposure to EMF has health effects or not. Hence, the state of knowledge is assessed by ICNIRP and other expert groups. The members of the expert groups are mainly epidemiologists and people from various research environments with expertise in e.g. animal experiments and cell experiments. The Norwegian Radiation Protection Authority keeps itself up-to-date on the state of knowledge and follows ICNIRP's assessments in its management of EMF, cf. The Radiation Protection Regulation § 34.

It is unclear to us what you mean by the concept of medical effects and how you distinguish it from the concept of state of knowledge. The Radiation Protection Authority's mandate is to refer to and inform about the state of knowledge. The medical effects documented [resulting from] exposure from EMFs are included in the definition of state of knowledge. The Norwegian Radiation Protection Authority has no mandate to diagnose individuals believing they suffer from exposure to EMFs. These are referred to the healthcare system for follow-up. In an administrative context, it is therefore not relevant to request any medical expertise as to health effects from EMFs among the Radiation Protection Authority's employees. The Radiation Protection Authority houses a highly educated and competent interdisciplinary environment with formal expertise in, among others, [physics and other «hard»] sciences, epidemiology and law.

With regards

Ole Harbitz
direktør

Hanne Kolstadmoen
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Figure 12: Letter stating that the Norwegian Radiation Protection Authority does not have in house expertise on health risks from "non-ionizing" EMFs, but uses ICNIRP's guideline recommendations for protection against acute thermal damage as general exposure limits and considers ICNIRP based literature reviews to constitute "the state of knowledge". (Content is translated from Norwegian and pasted into original.)

The Radiation Protection Agency (DSA) thus appears as a political body that “clears the air” as to the issue of radiation and dirty electricity from AMS meters by repeating “established truths” rather than objective, balanced, research-based knowledge. Typically, this position is expressed as claims in information material, stating that the radiation from AMS meters is purportedly so weak and rare that it cannot possibly cause harm, and that the radiation from an AMS meter is far weaker than from a mobile phone, in addition to emitting at only thousandths of the recommended exposure limits.

Such claims which are simply incorrect, constitute the basis used by the Norwegian Water Resources and Energy Directorate (NVE) and by the electricity network companies in their information to electricity consumers. It may still be found on their websites.

Figure 13 shows real signalling from two AMS meters (right) compared with two mobile phones (left). It appears that the pulsations from the meters are much stronger and more frequent than those from mobile phones (on the left). Distance from source and scales are equal. The Aidon meter’s pulsing is particularly frequent.

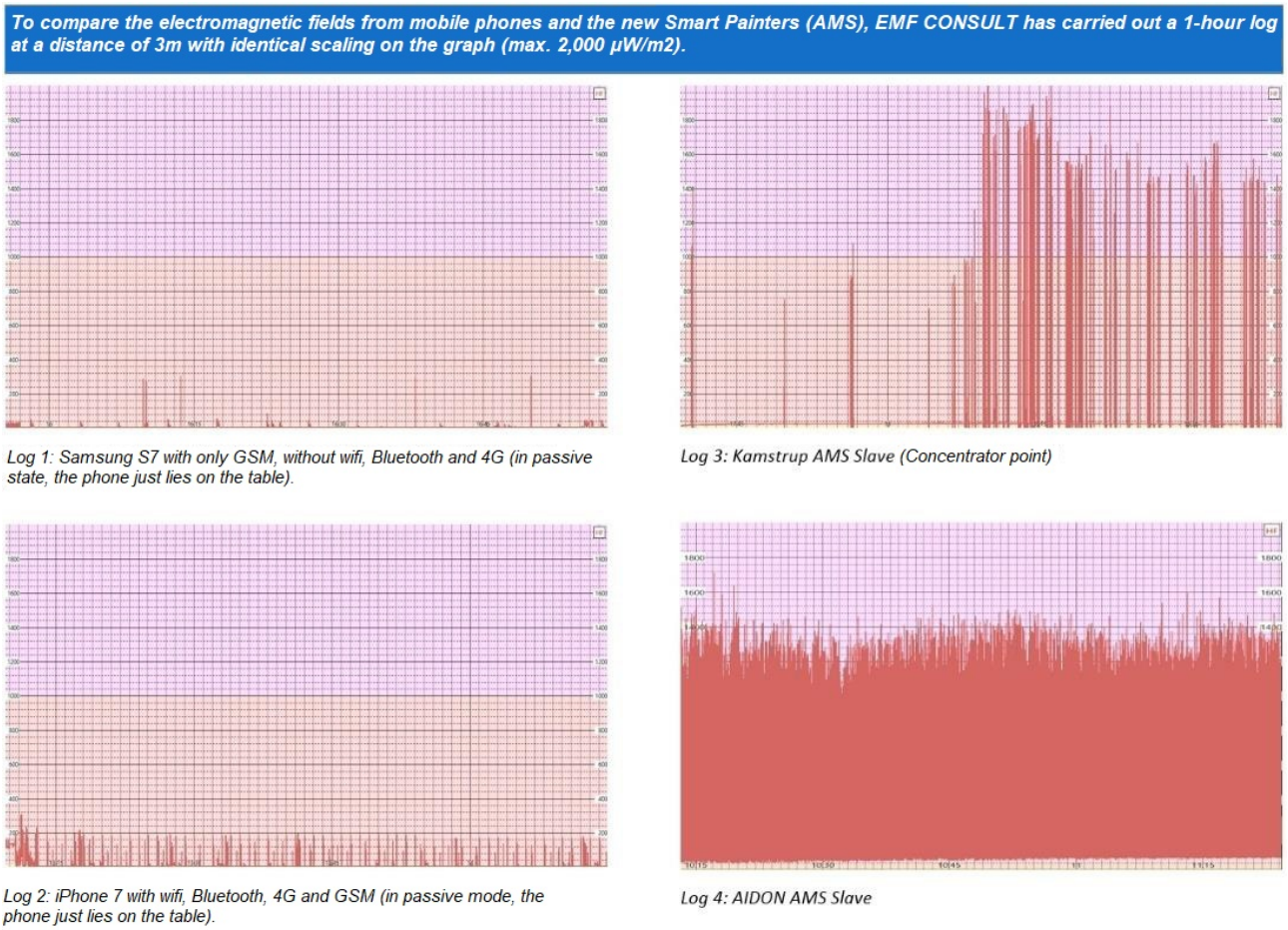

Figure 13: Signal strengths from two mobile phones, switched on, in "passive" mode (Samsung S7 and iPhone 7, left) and two AMS meters (Kamstrup and Aidon, right). Same distance (3m), same scales (2,000 µW/m2, 1 hour). Measurements in the field carried out by EMF-Consult AS.

AMS meters as well as mobile phones use dynamic regulation of the transmission power, which means that they adapt the emitted energy intensity to the conditions. In regulations and in comparisons, the maximum output power is therefore always the power referred to, i.e. the maximum level permitted (0.5 Watts e.r.p.). This is for AMS meters regulated by the “free use

regulations” (permitting unlicensed use when emissions are below ICNIRP recommendations, and of less duration than 10 minutes per day).

From AMS meters, the maximum output power is 3-4 times stronger than from mobile phones. EMF Consult documented that the RPA’s claims were based on it having mixed up measurement methods (e.r.p. versus e.i.r.p.). When correcting, it turns out that the relationship between AMS meters' signalling strength and mobile phones is the reverse of what the RPA had claimed. The maximum output power for AMS meters is several times greater than for mobile phones, not much less, as claimed in the RPA’s “factsheet” on AMS meters, Stråleverninfo 09-2017 (see Ref. 114).

The Norwegian Radio Protection Authority admitted after a period of tug-of-war that a mistake had been made, but refused on request to correct it by informing the Norwegian Water Resources and Energy Directorate (NVE) and the electricity network companies. In stead, the RPA only silently revised its bewildering factsheet.

This entire case is discussed in

> Ref. 132: Flydal, E: “Smart Meters: The Radiation Protection Authority clings to its misinformation”, blog post 27/06/2018, https://bit.ly/3GstCBH *
>
> Ref. 133: Retouched version of the fact sheet *Strålevern Info 09-2017*, https://bit.ly/3jDVgCR †

2.16 Who is responsible for this calamity?

It is difficult to avoid raising the question of who is responsible for the health risks associated with the introduction of the AMS meters. Is it the Radiation Protection Authority (in Norway: DSA), who obviously gave misleading information? Is it the Norwegian Water Resources and Energy Directorate (NVE), which should know that the AMS meters would be based mainly on wireless communication, but has taken responsibility of the functional requirements only, not the technical implementation methods, although knowing very well the options at the table? Are the individual electricity network companies the responsible ones, as they joined together in various groups responsible for technical requirements and the choice of suppliers for the equipment?

We are not in a position to provide the answers, but will list some points for those who wish to dig further into this topic or look for tips for where to look in their own country:

- Several of the expert testimonials that we have reproduced above came early enough that they could have been captured by the pilot projects and in the preparatory phases, and could have led to the choice of other technical solutions.
- The project's documents show that the Norwegian Water Resources and Energy Directorate (NVE) limited its responsibility – in line with modern governmental thinking – to be in charge of specifying functional requirements and managing the reshaping of the sector in which the AMS meters are part. The responsibility for the choice of technical solutions the NVE left to the electricity network companies. The electricity network companies’ responsibility must therefore necessarily also include responsibility for communication solutions and for EMC compatibility, CE certifications, to perform impact assessments, etc. However, it also appears, e.g. from a SINTEF Energi consultancy report, that the Norwegian Water Resources and Energy Directorate

* “Smartmålerne: Strålevernet biter seg fast” (Norwegian), https://einarflydal.com/2018/06/27/smartmalerne-stralevernet-biter-seg-fast/

† https://einarflydal.com/wp-content/uploads/2018/06/StraaleverninfoRETTET-09-2017-smarte-stroemmaalere-ny-versjon.pdf

was fully aware and consenting that microwave radio would be the pivotal communication technology.

> Ref. 134: SINTEF Energi AS: “Evaluation of NVE's guide to safety in AMS” – consultancy report prepared for NVE, 44, 2017, https://bit.ly/3C80EV2 *

- Well before 2017, after the so-called AMS hearing in spring of 2011, FELO, the Norwegian Association for the Electro-Hypersensitive, sent questions about whether electro-hypersensitives would be exempted from AMS meters and pointed out the problems that would arise for those living in blocks of flats. FELO’s concern at the time was microwaves, not dirty electricity, nor privacy or other AMS functionalities linked to automatic reading. NVE stated in a regulatory decision of 24 June 2011 that opt outs would be granted, but only in cases of documented health issues, later restricted to acute issues, and left to the grid companies to grant, with NVE (later an arbiter organisation for the energy market) as the body of appeal. A meeting with FELO at NVE was also held on the issue, resulting in a letter stating that exemptions would be given.

  In other words, already before 2012, several years before the meters were rolled out, NVE was deeply involved in the choice of technology and informed on possible health issues.

  > Ref. 135: Letter from the Norwegian Water Resources and Energy Directorate (NVE) to FELO, ref. NVE 200701944-252 ek/ave, 14.03.2012, on exemption for electro-sensitive persons, https://bit.ly/3CEul0g †

- We are not aware that NVE itself carried out any impact assessments of health and environmental aspects, or requested any for an assessments of health and environmental consequences whatsoever. Neither did SINTEF Energi AS have any comments on this in the above-mentioned report, despite the fact that at this time there was already considerable evidence from the USA and other countries indicating health and environmental issues from the strongly pulsed wireless technology used for AMS meters and from dirty electricity in the grid, created by Switched Mode Power Supplies (i.e. standard, electronic power supplies).
- We are not aware that any Norwegian network company has carried out such investigations into health and environmental consequences of the AMS introduction.
- During the entire planning period, there have been plenty of research reports pointing at increased health risks from microwave radiation, also in the contexts of AMS meters.
- Strong warnings and misgivings were presented in the central Norwegian technology community regarding the health effects of microwave radiation, and these were discussed.

  > Ref. 136: “Possible health damage as a result of low-power electromagnetic radiation”, note by retired director of technology in Televerket/Telenor ASA, Ole Petter Håkonsen, dated 1st October 2019, published on the alumni website of the former Norwegian Telecom Directorate’s Research Institute, January 2021‡ (excerpt):
  >
  > “At the Christmas meeting of the Norwegian Academy of Science and Technology (NTVA) in 2011, the Swedish professor Leif Salford from the University of Lund and cand. scient. Sissel Halmøy from Folkets Strålevern [the NGO The People’s Radiation Protection] each gave interesting lectures on new research indicating that health damage may also occur at

* Evaluering av NVEs veileder til sikkerhet i AMS (Norwegian), https://einarflydal.com/wp-content/uploads/2019/12/SINTEF-Evaluering-av-NVEs-sikkerhetsveileder-rapport2017_44.pdf

† https://einarflydal.com/wp-content/uploads/2023/01/2016-12-07_NVE_dispensasjon-AMS.pdf

‡ “Mulige helseskader som følge av laveffekt elektromagnetisk stråling” (Norwegian)

much lower radiation values than the Norwegian exposure limits. On the basis of the uncertainty thus having been created, several countries had, it was reported, already started work on “precautionary”-type measures to limit radiation for those who so far seem to be most exposed – primarily children and young people.

In a separate post, however, the representatives from the National Radiation Protection Agency denied that the new research results would lead to changes to the established exposure limits in Norway.

The audience, who were mainly elected members of NTVA and thereby presumably experienced researchers and engineers, however found the Norwegian Radiation Protection Authority's rejection of the new research results thought-provoking and the discussion continued during and after the subsequent dinner. …

The combination of great uncertainty and the possibility of serious health consequences in the population should – in my opinion – have led to the authorities many years ago establishing a “precautionary” principle and – pending results from publicly controlled and independent investigations were present – the introduction of stronger limitations on the permitted radiation intensity.

The reason why this has not happened may be related to the fact that the same authorities too quickly flagged their view based on a few early studies initiated and financed by the industry itself.” (emphasis added)

2.17 The AMS meters chosen in Norway and in many other countries are a particularly unfortunate combination of properties

In this section, analyses made by the physicist Ronald M Powell on AMS meters and health risks are referenced. Powell criticises AMS meters of the kind having been introduced in Norway for being the most unfortunate technical solution available in terms of health, privacy and safety.

In one of several notes he has written about AMS meters, Ronald M. Powell, a Harvard graduate in applied physics, concludes that the AMS meters used in Norway are a particularly unfortunate combination of properties:

> Ref. 137: Ronald M. Powell: “Ranking Electricity Meters for Risk to Health, Privacy, and Cyber Security”, pdf note, 3rd edition, dated 12 November 2015, https://bit.ly/3vrt48M*

The AMS meters constitute a point where the wireless industry and the electricity industry meet. Powell’s view is that the AMS meters are a particularly unfortunate offspring, and so for several reasons:

- AMS meters are installed with microwave transmitters and communication patterns that are biophysically highly active, and so around the clock
- AMS meters add dirty electricity from power supplies and processors to the electricity network, inside the house as well as outside

* https://einarflydal.com/wp-content/uploads/2019/12/Ronald-Powell-289782183-Ranking-Electricity-Meters-for-Risk-to-Health-Privacy-and-Cyber-Security.pdf, Norwegian translation: https://bit.ly/3VwkGiN, or https://einarflydal.com/wp-content/uploads/2020/12/Ronald-M-Powell-Rangering-av-malere-v-1.1.pdf

- AMS meters cannot be switched off without also turning off the main switch, i.e. the home's electricity supply.

The AMS meters thus impose on the users, exposure to an increased biophysical load which the users cannot avoid if they wish to receive electricity supplies from the grid company. The customers may themselves remove or shield all other sources of dirty electricity and radiation in the house – temporarily or permanently – without losing the electricity, but not so with the AMS meter.

The grid companies have for long envisioned a future of themselves being caretakers – by controlling the AMS meters – to a huge market for in-house services, as part of the Internet-of-Things vision. Modern AMS meters are designed to support such in-house service development, supplied by the grid company or by third party service providers. Also, the constant pulsing, a signal per 0.6 second in the case of Aidon meters, is used to monitor the electricity grid.

	Meter Type	**Communication type**				**Total risk** 5 is the highest. Empty cell is lowest		
			Wireless	Cable		Health risk	Privacy risk	Risk regarding online security
G	Smart meter	WAN / HAN	✓			5	5	5
F	AMR-meter	Bubble-up (every sec)	✓			4	4	
	Analog meter (with wireless digital electronics)	Bubble-up (every sec)	✓			4	4	
E	AMR-meter	Wake up (on request)	✓			3	4	
	Analog meter (with wireless digital electronics)	Wake up (on request)	✓			3	2	
D	Smart meter	Internet cable/fibre		✓		2	4	4
	AMR-meter	Internet cable/fibre		✓		2	4	
C	Smart meter	Fixed telephone line		✓		2	3	2
	AMR-meter	Fixed telephone line		✓		2	1	
B	Simple digital electronic meter	Not applicable				2		
A	Traditional analog meter	Not applicable						
	SMART METER	*PLC (mains)*		✓		3	5	2

Figure 14: Ranking of AMS meters according to health, privacy and safety properties of the technical implementation (5: highest risk) (from Powell 2015)

The meters that have been rolled out in Norway and in several other countries, are the most modern in all these respects. The dominant type of AMS meters now in use in Norway, regardless of make or model, is the kind which in Powell's table (Figure 14) is indicated as “G SMART METER”, using a WAN (Wide Area Network) and HAN (Home Area Network).

However, these meters are also the ones in Powell's ranking that score worst on health, environmental and safety risks. Powell's article reviews the ranking criteria and justifies the ranking carefully and systematically. The meters with the best scores, are the traditional, old analogue meters.

3. Wireless communication and dirty electricity produce pulsed electromagnetic radiation

This section provides a general review for the layman of technical terms and their explanation, such as “radiation”, “dirty electricity” and “pulsing”.

Emphasis has been placed on simple explanations for people who are not well versed in electrical and radio technology. It is explained how both wireless communication, alternating current and modern electronic equipment are sources of many different types of electromagnetic pulses that emanate quite far, although they are quickly weakened, or attenuated, with distance.

In the following it is shown that dirty electricity” and “pulsed radiation” are essentially different terms covering the same phenomenon, and that the phenomenon is common to electrical current as well as to radiation from antennas: sharp shifts in electromagnetic fields.

3.1 Relevance

The general explanations given here elaborate and substantiate the claims that, and explanations as to how, AMS meters trigger health and environmental problems, given in other parts of this book. The explanations given here therefore have direct relevance to AMS meters – both as regards the AMS meters' transmitters as well as regards the meters themselves when the radio is dismantled or deactivated – and is therefore, strictly speaking, no longer an AMS meter, but just an electronic meter.

This chapter essentially conveys standard textbook material on basic physical phenomena. Where the text deviates from this, or uses some particular material, sources are given.

Why such a walk-through of these concepts? It is done to provide the necessary, physics-based, academic basis to to make understandable that man-made energy fields in the form of electricity and radio waves can affect biology through various forms of *interference*, in the same way equipment can be affected: That electrical and electronic equipment can be affected is well-known within electrical and electronics disciplines. It is referred to as electromagnetic compatibility (EMC) problems. Still, it is far less well known that biophysics is affected, and that biological processes may be affected even by amounts of energy that seem very modest. As we have seen in the book's earlier chapters and will also see later, such knowledge is even actively opposed.

It will become clear that AMS meters are a source of *dirty electricity* that cannot easily be removed unless turning off the electricity mains, i.e. all electricity, and a source of *interference* that one does not immediately become aware of, nor can easily remove. This fact adds to the living environment a potential health problem and a biophysical burden that may result in damage on health and environment. Through this chapter as well as the other parts of this book, you should find this to be well underpinned.

3.2 Radiation, waves and frequencies

Here, some basic terms are explained which are textbook material, and it is shown that the distinction commonly made between ionizing” and “non-ionizing” radiation is misleading.

By *radiation* it is meant *electromagnetic radiation*. Such radiation can be described as *waves of electric and magnetic charges* emanating from a source. Light is one such form of electromagnetic radiation, but there is a wide spectrum of radiation types. Radiation may have different wave frequencies, that is, how many wave crests pass per second. The frequencies are expressed in Hertz

(named after a physicist), abbreviated Hz. One Hertz means that one wave is emitted per second, while for example 1 MHz means that one million waves are emitted per second.

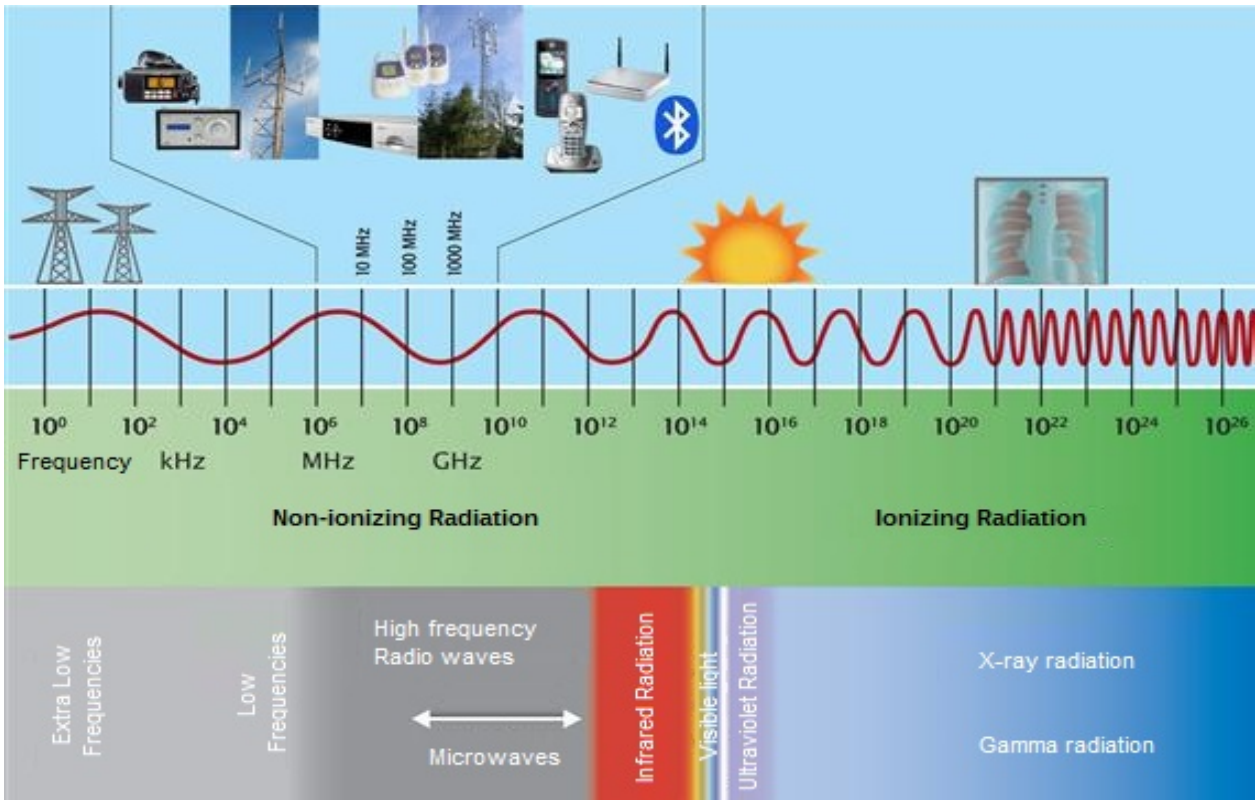

Figure 15: The electromagnetic frequency spectrum.
Hz indicates the number of times a wave crest passes per second.
1 MHz is the frequency at which one million wave crests pass per second.
(source: FHI report 2012:3 (translated))

In Figure 15, the part of the electromagnetic spectrum that is relevant in our context is shown to the left: the grey area of so-called "*non-ionizing radiation*".

The term "non-ionizing radiation" is often used in science and medicine and often incorrectly as synonymous to "non-harmful":

That some radiation is considered "non-ionizing", means that it is considered too weak to create *ions*, i.e. variants of a molecule (or atom) where the molecule has a different electric charge than normal. But this is wrong and misleading: In part, the frequencies covered by the term "non-ionizing", may create ions directly by affecting weak bonds in molecules, in part indirectly through various common and essential biological mechanisms.

> Ref. 138: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW, Chapter 11 (p. 176)*
>
> Ref. 139: Hecht, Karl: "Is the division into ionizing and non-ionizing radiation still relevant? Latest scientific knowledge: EMF radiation can generate excess O_2 and NO radicals in the human body", research report, Competence Initiative for the Protection of Man, Environment and Democracy e.V., 2015, http://kompetenzinitiative.net/†

* https://www.safertechnology.co.nz/wp-content/uploads/2021/04/ELECTROSMOG-May-2021.pdf We relate to the Norwegian edition: Susan Pockett: Stråletåka – Helse- og miljøforurensningen fra mikrobølgene, 237 pages, Z-forlag, 2020, ISBN 978-82-93187-50-9.

Of the so-called non-ionizing" radiation, in practice the frequencies below visible light, the most high-frequency part, in Figure 15 to the left of the centre, is designated as HF or UHF (ultra-high). This part of the spectrum consists of radio waves (RF), which in the upper part includes microwaves (MF/MW). The frequency range furthest to the left is called low frequency (LF) or ULF (ultra-low). Here we find, among other things, the frequencies that come from ordinary power lines with household electricity, and the electrical current in high-voltage lines.

Microwave radio frequencies span from around 800 MHz (800 million Hz) up to 300 billion oscillations per second (300 GHz). AMS meters may use cellular (mobile) communications, in which case they would use waves with frequencies around 1-2 billion oscillations per second (1-2 GHz). By comparison, audible sound has a frequency range from approx. 20 Hz to 20,000 Hz, i.e. to 20 kHz.

The radio waves used for information transmission from AMS meters in so called *mesh networks* (networks where they may all "talk with each other" and automatically configure and re-configure with whom, use a frequency of around 870 MHz (meters of the brands Nuri and Aidon) and 444 MHz (brand Kamstrup), i.e. slightly below the microwave range.* These are – for these applications – the "basic" frequencies, or *carrier waves*, used to "carry" the information to be transmitted. The transmission is done by modifying these waves, called *signal modulation*. In modern digital radio, the carrier waves as well as the modulated signals are sent out in the ether as *pulses*. The technology is called *pulse modulation*.

Household power cords emit electromagnetic waves of 50 Hz out from the wires. The area around the wire where the waves can be measured is referred to as *the electromagnetic field* around the wire.

"*Dirty electricity*" is a used as a general term in the electricity business for waves that deviate from 50 Hz, and may consist, as we shall see, of many different frequencies and shapes from the entire spectrum of non-ionizing" radiation.

Frequency is also used in a different sense when denoting household electricity and other kinds of *alternating current*. In this case, "frequency" indicates how often the electric current changes direction. Their frequent change of direction are precisely what characterises alternating current: Household electrical current has a constant frequency of change of direction: 50 times per second, i.e. 50 Hz. (In the US and some other countries: 60 Hz.)

3.3 Electromagnetic waves are created by varying electric current

Here, more basic textbook material and connections to health and environmental issues are explained.

On a website from Western University, Illinois, a simple explanation is given as to how radio signals arise, i.e. how electromagnetic waves arise. This explains how *radio transmitters, household electricity and dirty electricity give rise to electromagnetic radiation as this is made up of such waves:*

† German original: "Ist die Unterteilung in ionisierende und nichtionisierende Strahlung noch aktuell? Neuester wissenschaftlicher Erkenntnisstand: EMFStrahlung kann O2- und NO-Radikale im Überschuss im menschlichen Körper generieren", Forschungsbericht, Kompetenzinitiative zum Schutz von Mensch, Umwelt und Demokratie e.V., 2015

* Frequencies are subject to local regulations by country, here the case of Norway.

Ref. 140: How do you make a radio wave?, Western University, Illinois, https://www.qrg.northwestern.edu/projects/vss/docs/Communications/3-how-do-you-make-a-radio-wave.html

“How do you make a radio wave?

When a direct electrical current is applied to a wire the current flow builds an electromagnetic field around the wire. This field sends a wave outward from the wire. When the current is removed, the field collapses which again sends a wave. If the current is applied and removed over and over for a period of time, a series of waves is propagated at a discrete frequency. If the current changes polarity, or direction repeatedly, that could make waves, too. This phenomenon is the basis of electromagnetivity and basically describes how radio waves are created within transmitters.”

In wires with alternating current, the current constantly change direction. As previously mentioned, this happens 50 times a second in European household electricity. In other words, electromagnetic waves are created with 50 wave crests and troughs per second.

This means that when the electrical current in a wire or in an antenna changes, an electromagnetic wave is emitted that oscillates in step with the change. This is a fundamental physical phenomenon that occurs independently of the reason for such a change happening. In radio transmitters, the change is deliberate, while for dirty electricity it happens arbitrarily.

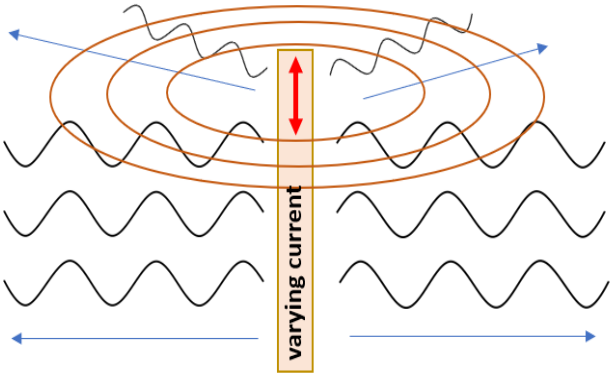

Figure 16: Electromagnetic waves being emitted from a simple antenna in all directions along its entire length

This phenomenon, i.e., that a wire with varying current will act as an antenna and emit electromagnetic waves into the surroundings, has been known since the days of the physicist Maxwell (1832-1879) – even though the word “antenna” was not used. It follows from Maxwell's 4th equation, which may be formulated as “circulation of a magnetic field = current”:

Ref. 141: Blundell, Stephen: Magnetism – A very short introduction, Oxford University Press, 2012, p. 47:

“Maxwell realized that these changes in electric field will produce changes in magnetic field, and vice versa, and that a self-sustaining wave of varying electric and magnetic fields will propagate off into space. Maxwell had predicted the existence of an electromagnetic wave. (In fact, the oscillating voltage in the wire, that caused the whole thing in the first place, is nothing more than a radio transmitter.)”

In an antenna for digital radio communication, the current is manipulated so that pulses of varying electromagnetic waves are created. The information to be sent is coded in the form of *pulse patterns*. See e.g. Figure 25, or on this book's cover.

An electromagnetic wave that “ripples” outwards, see Figure 16, consists of a smooth and synchronized alternation between different electric and magnetic charges. (This is standard textbook presentation. It is not completely correct physics, but that is not so important in our context.) When

the change in current stops, the waves stop, too. When the current starts changing again, waves will occur again.

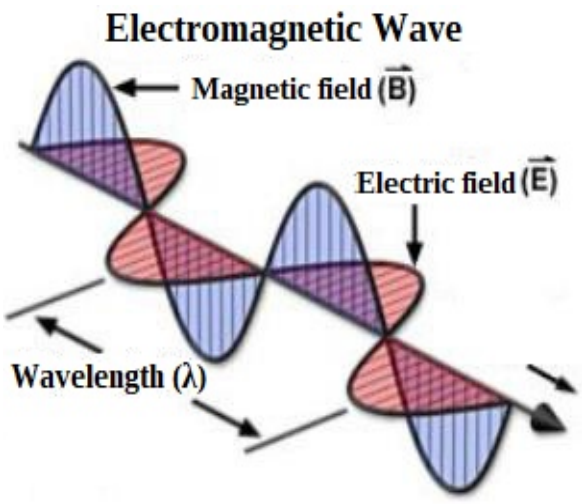

Figure 17: A wave in electric and electromagnetic fields

The *frequency* of the waves (i.e., the time it takes between wave crests) is determined by how quickly the changes occur in the current: The faster the changes occur, the *higher* is the frequency. The strength, or *power*, of the waves, more precisely the *amount of energy* or the *energy intensity*, is expressed in the form of the *wave height*, called the *amplitude*. The amplitude is determined by how large the change in the current is.

We see from Figure 17 that electromagnetic waves consist of synchronized oscillations of electric and magnetic fields. This means that when a wave passes an electrically changed particle, like an electron, the changes in the electric field of the wave will make the particle move back and forth in sync with the field's change, just like a boat will rise and fall in waves of water. Similar for a magnetic charge.

3.4 Loss of energy

Here it is explained that the radiation from an antenna loses it power quickly by distance, but reaches infinitely far, and that it might reach further in the form of dirty electricity. In practice, a home is fully immersed in the dirty electricity from the domestic electricity wires. By interference, unforeseen weaker or stronger fields may occur.

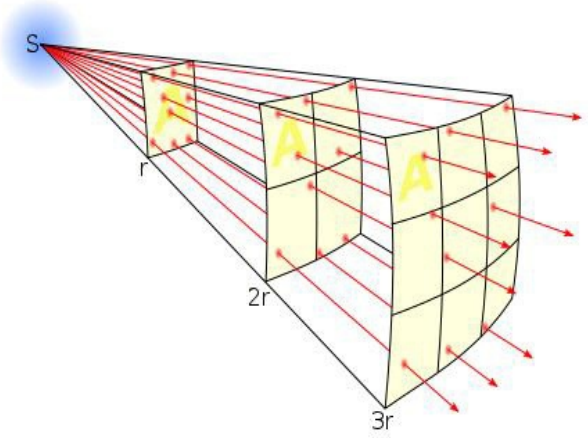

Figure 18: The radiation thins out to a quarter when the distance is doubled (source: Wikipedia)

When electricity passes through *wires*, the loss with distance is very small. For practical purposes, we consider it close to zero. Therefore, changes in the velocity of electrical energy will propagate so that they are equally strong throughout *the domestic network of electrical wiring*. This means that the electric fields around the wires will also be equally strong – as long as other conditions like distance and shielding are equal. It also means that there will easily be electrical influence in the domestic power grid from sources outside – unless protective *filters* have been set up against such impact.

Electromagnetic waves through empty space reach infinitely far. Nevertheless, the energy in the field becomes weaker and weaker the further away from the source we measure, since the radiation spreads: Just like the light gets weaker the further away from the light source we go, the “non-ionizing” waves – i.e. the rays – also become thinner and thinner the further we get away from the source. This is simply similar to the fact that

the distances are greater between the spokes in a bicycle wheel the further away from the hub we measure.

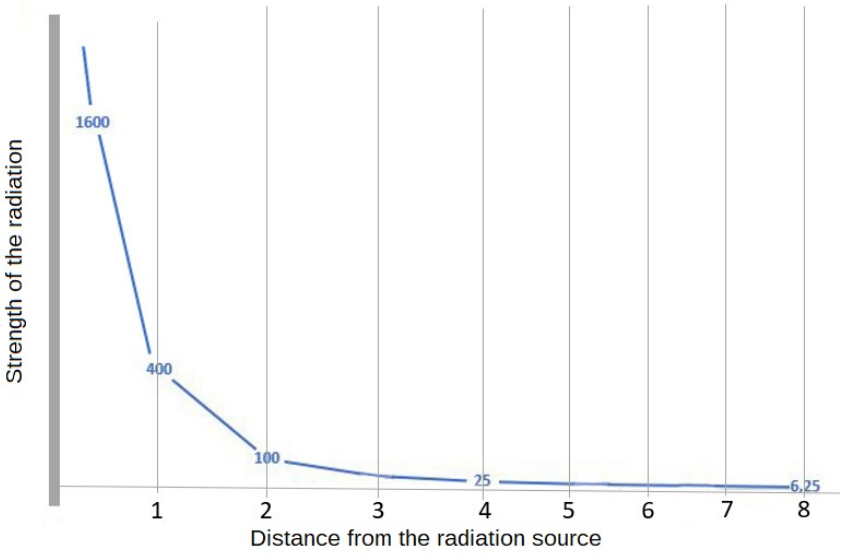

Figure 19: The strength/energy of the electromagnetic field drops quickly when the distance is increased. At the double distance, the energy is reduced to a quarter.

When electromagnetic waves — including radio waves and light — are emitted from an omni-directional source, such as a light bulb, an antenna, or a wire, they emanate, or spread, in all directions. The rays are spread outwards in space, i.e. in three dimensions, and the energy is therefore reduced to a quarter each time the distance is doubled.

Figure 18 shows how the distance gets longer and longer between each *wave*, *ray*, or *beam* radiating from the source (red arrows). At a given distance (r), we see nine rays passing through a certain area (A).

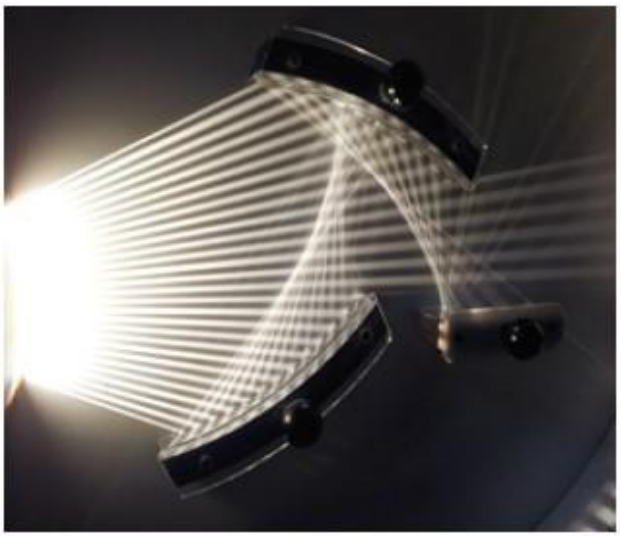

Figure 20: "Hot spots" – concentrations created from reflective surfaces

At double the distance (2r), it goes down to a fourth. At three times the distance far (3r), only about one ray passes through the same area.

This pattern applies as long as the radiation is not reflected or absorbed by something it encounters, e.g. metals, water, concrete or other.

Figure 19 shows the same as a graph, i.e. how exposure weakens with distance.

What we have described are conditions that apply when analysing the situation around a single source of electromagnetic radiation.

In practice, the situation is far more complex, with several sources, electrical conductors and other metal objects, reflective surfaces, damping materials, etc. in the surroundings. Then we are faced with phenomena such as *reflection, induction and interference* which can carry and/or amplify electromagnetic waves so that they reach far greater distances than indicated by the simple mathematical calculations for any single source. More about this follows below. A simple situation where rays are reflected and concentrated into so-called "hotspots", i.e., with much higher energy, is illustrated with a lamp and two curved mirrors in Figure 20: the lighter the spot, the more energy is concentrated there.

3.5 Household electricity: “soft waves” – destroyed by dirty electricity

Here too, basic textbook material is explained. Also, “dirty electricity” is defined here, and the connection to health effects is exemplified. It is shown that dirty electricity may contain many different high-frequency components, even such as microwave, pulsed radio.

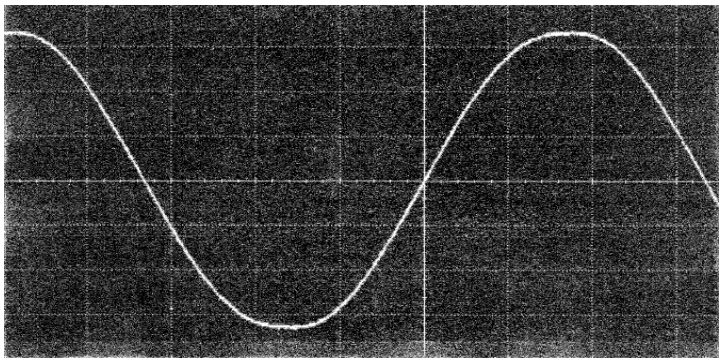

Figure 21: Sinusoidal current (“pure current”). Horizontal axis: time, vertical axis: charge

For households, grid companies supply alternating current with a *frequency of 50 Hz* (Europe and most other countries), i.e. electrical current that changes direction 50 times per second.

With an oscilloscope you can see that these changes take place gradually. They appear as smooth *sinusoidal waves* around a *zero line*, where the electric charge is zero (Figure 21).

“Dirty electricity” is an inaccurate collective term with its roots in the electricity business itself, used to designate current with various kinds of deviations from the sine wave. Hence, it is used as a general term for “polluted electricity”. Dirty electricity is what you observe when the sine waves are not being drawn evenly on the oscilloscope, but are distorted.

> Ref. 142: Magee, Steven: Toxic Electricity, Edition 2 – 2013, ISBN 9781475295696, pages 247-269 which is also printed in Magee, Steven: Electrical Forensics, Edition 1 – 2013, ISBN 9781492118909, pages 216-238

A slightly more narrow definition is cited below, quoted from:

> Ref. 143: Lloyd Morgan: “Blood Glucose Levels A Study of Correlation Factors”, PDF, revised 6/16/03,https://bit.ly/3HsjRnD*:
>
> “We have come to call these high frequency transients, “dirty power”.
>
> “Dirty power” is also referred to as “transients”, “noise” or “stray voltage” and similar terms. Clean power is when the electricity we use is solely in the form of a 60 Hz sinusoidal voltage and current without high frequency components. Dirty power refers to high frequency (>10 kHz) components riding on this sinusoidal wave. Dirty power is a component of the 60 Hz power [mostly 50 Hz outside the USA] to which, in our modern electrified world, we are all exposed, in varying degrees.”

The physical mechanism that underlies the occurrence of dirty electricity is the one we explained above:

Every time there is a shift of voltage in the power grid, in addition to the alternating current changes, a sudden pulse – an energy variation – will be sent out in the electromagnetic field around the wires. We are therefore talking about energy variations that add to the 50Hz shifts due to the alternating current.

In a house with dirty electricity, such “extra” energy variations – pulses – are sent through the electricity wiring, and therefore also out from the wiring network in the form of electromagnetic radiation. The house wiring thus works as an antenna – in the same way as the special purpose

* or https://www.stetzerelectric.com/wp-content/uploads/Morgan-blood-glucose-correlation.pdf

wires we call “antennas” and use for wireless communication – such as WiFi, mobile phones, smart meters, etc. – send out pulses of electromagnetic radiation to transmit some content.

Such varying voltage occurs whenever the power grid is exposed to sudden, possibly constantly repeated, small or large loads. In their simplest form, they stem from, for example, a power switch being turned on or off. Thus, a power grid completely without pulses is in practice not imaginable.

The problems rise when there are large amounts of such pulses:

Important sources of dirty electricity in today's society are particularly *chargers* and other *digital power supplies*. These are also *transformers*, i.e. they transform the voltage in the household current, which is in Europe 220 Volt and 50 Hz (though 230 V in the UK and 240 V in Norway), into voltages with other characteristics, often what we call “low voltage”, e.g. 12 Volts. Simultaneously, they transform the current from alternating current to direct current (DC), i.e. current that only flows in one direction through the wire (and back through the return wire). Such *converters* are today built into a great deal of electrical equipment.

The technique used by these transformers is called *SMPS*, “*switched mode power supply”*:

This technique involves switching the power on and off quickly, preferably several thousand times per second, in order to “choke” the amount of power – and its direction – that is extracted from the mains and passed on to the electronic equipment. This technique is used in almost all modern electronics, including the power supplies of computers, chargers for mobile phones and electric cars – as well as for the power supplies in AMS meters and all other electronic meters, water meters, even in LED lamps, regardless of whether they have transmitters embedded or not.

On the other hand, such power supplies are not found in the old, mechanical electricity meters equipped with turntables and mechanical counters.

> Ref. 144: Dr. Magda Havas: Health Concerns associated with Energy Efficient Lighting and their Electromagnetic Emissions, response to Request for an opinion on “Light Sensitivity” from Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), June 5, 2008, https://bit.ly/3Je0Zdc*

Havas shows that modern *fluorescent energy-saving light bulbs* create much more *electrical noise* both in the air and in the wires, than traditional incandescent light bulbs, which have now been phased out (Figure 22).

In addition, all objects containing digital electronics create dirty electricity. As they contain processors that switch the current on/off at very high rates, thereby creating pulses in the wire they are connected to, this is simply unavoidable. An AMS meter, too, whether with or without built-in radio transmitters, has an SMPS as well as other equipment that will create “disturbances”.

All these different sources of dirty electricity produce stronger or weaker, short or even ultrashort voltage shifts in the electricity wires. Some sources do at fixed frequencies, while others more at random. Some do continuously, while others produce dirty electricity every now and then when turning something on and off.

Even fixed and stable frequencies may give rise to other frequencies: They create their *harmonic frequencies*, in music called *overtones* (see below).

Also, in the case of *several sources*, which is pretty normal in a domestic wiring, extra frequencies from interference between frequencies from these various sources might arise (see below).

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* or https://www.magdahavas.org/wordpress/wpcontent/uploads/2009/10/08_Havas_CFL_SCENIHR.pdf

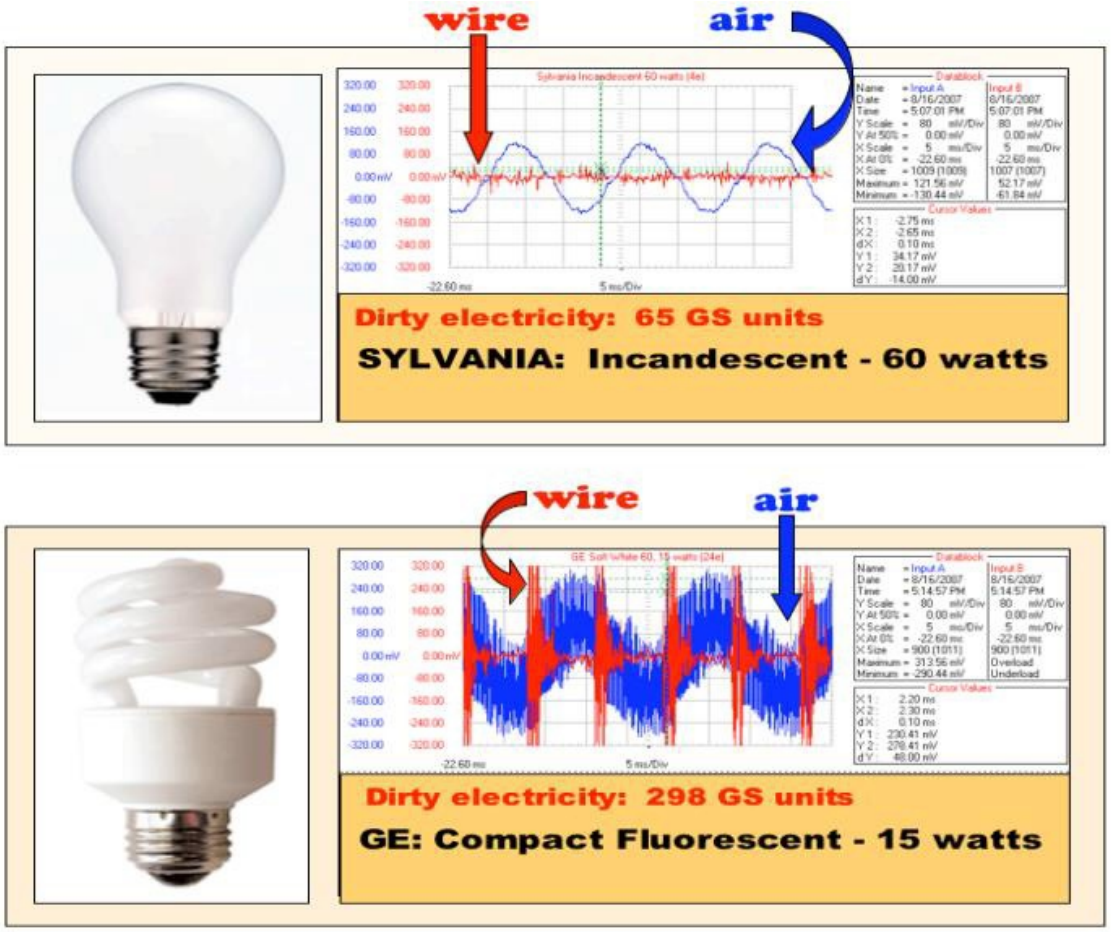

Figure 22: Differences between an incandescent lamp and an energy-saving light bulb in terms of production of dirty electricity and pulsed radio waves (Havas 2008)

LED bulbs, energy saving bulbs and dimmers use similar techniques to SMPS's and thus contribute to dirty electricity in the domestic power grid. Dr. Magda Havas argues that *photosensitivity*, which is an increasingly widespread health problem, seems linked to the huge production of dirty electricity in the domestic wiring from such energy-saving light bulbs.

As shown in Figure 22, dirty electricity may appear on an oscilloscope as sudden, extra pulses or wave crests. They are pointed and narrow, due to their much higher and/or more sudden energy raises and falls, as compared to the more soft and slow shifts in 50Hz alternating current (AC).

There are several technical terms in use in the electricity business for such shifts, including *transients*, which may both denote that they are short lived, and that they have a high penetrating ability. Dirty electricity may appear as single "*sparks*" (also called "spikes"). As explained above, they may appear as random transients, at fixed intervals, or as more or less regular and long-lasting *bursts of pulses*.

The graph below shows measurements of dirty electricity in the public library in Olympia, Massachusetts, USA. This example is from a particularly interesting project among the staff of the library, as measurements of dirty electricity and health parameters were followed up with the installation of filters, and thereafter a new round of technical and biological measurements, demonstrating substantial improvement:

Ref. 145: Samuel Milham & David Stetzer (2013) Dirty electricity, chronic stress, neurotransmitters and disease, Electromagnetic Biology and Medicine, 32:4, 500-507, DOI: 10.3109/15368378.2012.743909

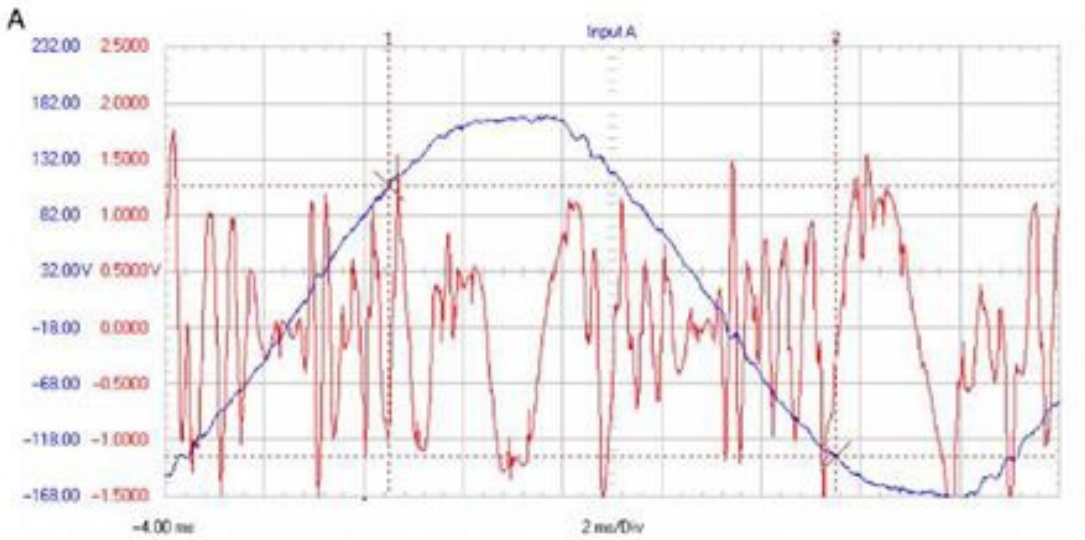

Figure 23: Measurements of "dirty electricity" in the office of the head of the library in Olympia, Massachusetts, USA. Blue curve: 50 Hz power supply; red: the disturbances, i.e. Dirty electricity. (Milham & Stetzer 2013)

The blue curve in the graph shows the normal current (the AC voltage) with its voltage disturbances shown as the slight deviations from a smooth line. The red curve shows these disturbances, i.e. the dirty electricity, stemming from electronics, converters, etc. The higher the curves, the more powerful the pulses emanating from the electricity wires.

When the pulsing occurs at fixed intervals, these intervals themselves form a fixed frequency in addition to the electricity frequency of 50 Hz. These frequencies, which are formed in addition, may be far higher than the frequency of the AC power, as shown in Figure 22 (blue curves), or they may have a lower frequency. Thus, the picture of different frequencies in play quickly becomes quite complex.

(In English, the term "*intermittent*" is often used to denote when pulses are not produced continuously, but come at fixed intervals as discontinuous *pulse trains* or *bursts*.

Strong biophysical effects seem linked to intermittent exposure, and exposure experiments are often carried out in this way – i.e. with shorter, successive periods of exposure, e.g. 10 minutes every day or a few times a day, I.e. without continuous irradiation.)

Chargers for electric cars might easily be identified on the power grid with their fixed, rather large intervals between each "chunk" they grasp from the grid.

Radio frequencies from a WiFi router (Figure 24) consist of a *carrier frequency* as well as both higher and lower frequencies: The carrier frequencies in use are usually 2.4 and 5GHz (two bands in use simultaneously), but as WiFi routers send a fixed "*beacon signal*", repeated 10 times per second, i.e. with a pulse frequency of 10 Hz. So, a WiFi router also sends a 10Hz signal. We can see from Figure 24 that also other frequencies are created.

AMS meters of the Aidon type have, in addition to the voltage noise from the power supply, radio signals that transmit approx. every 0.6 seconds. If induced in the mains, such signals will be reflected in the dirty electricity and spread pulses with a frequency of 0.6 Hz through the house.

The amounts of dirty electricity from technical equipment vary greatly with the quality of the equipment: Cheap components and little work done to ensure electromagnetic compatibility (EMC) often mean more dirty electricity from the electronic components and the power supply in the specific product.

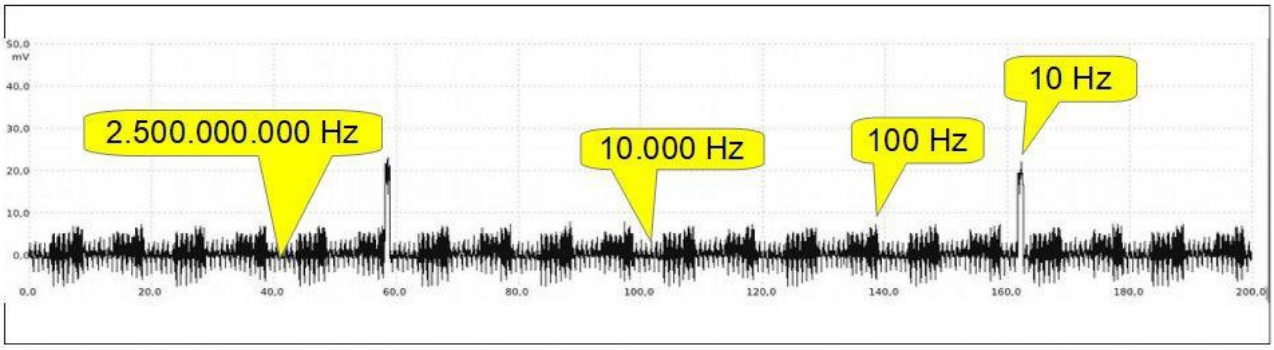

Figure 24: Different fixed pulse frequencies from an "inactive" WiFi router.
Carrier frequency: 2.5GHz. (measurement: K. Horsevad)

Digital communication normally uses intense pulse bursts. These have far higher frequencies than e.g. 10 Hz. Figure 25 provides an example, taken from a WiFi router while transmitting something.

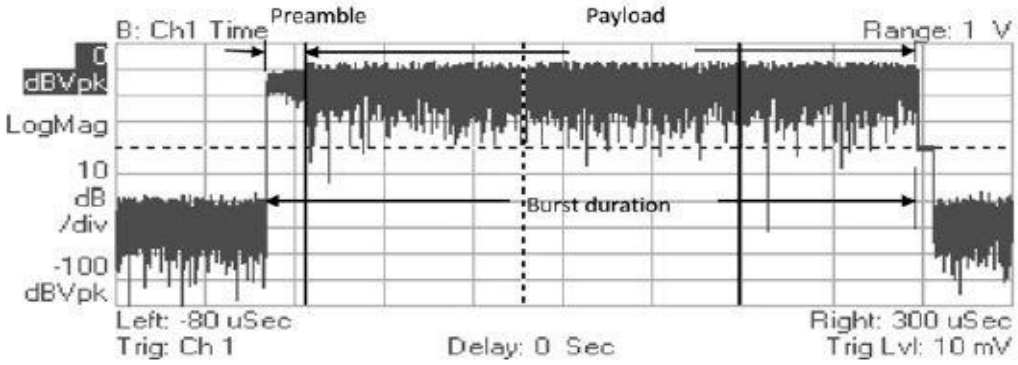

Figure 25: Pulse burst from a WiFi router
Here the total duration is a few tenths of a second (source unknown)

3.6 Harmonic frequencies, EMC

***Harmonic frequencies* are discussed here, normally just called "*harmonics*". They are formed physically like *overtones* in music. And they are closely linked to health effects.**

All forms of waves at any frequencies form *overtones*, or *harmonics*, according to fixed physical laws. We know this from music, where the harmonics formed give different instruments their distinctive timbers. Harmonics are formed upwards in the frequency spectrum at intervals equal to the *fundamental frequency*. Hence, if the fundamental frequency is 50 Hz, overtones will therefore be formed at 100 Hz, 150 Hz, 200 Hz, and so on. Gradually, the overtones will get weaker. Such new and higher frequencies formed above a fundamental frequency are also called *harmonics*.

Also waves in electromagnetic fields create harmonics. The harmonics in an electromagnetic field can be read with a spectral analyser, and sorted according to the frequencies occurring in the time period measured (Fourier analysis). In Figure 26 we see an example from such a measurement from an emanating source of some kind:

The fundamental frequency is the high peak on the left, and harmonics are shown as high peaks, with increasing frequency towards the right.

Depending on quality and technical requirements, electrical/electronic equipment has built-in filters to remove unwanted harmonics. Filters or other remedies are installed in order to ensure *electromagnetic compatibility* (EMC) so that other equipment should not be disturbed or damaged.

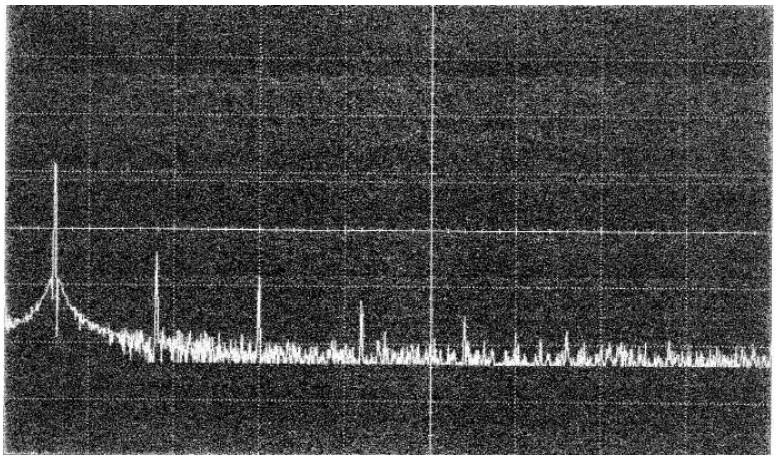

Figure 26: Harmonics Horizontal axis: frequency, Vertical axis: intensity (source: Magee 2013)

3.7 Electromagnetic radiation spreads far by “contagion”

Here are some examples of how electromagnetic fields (EMFs) may spread far through *induction*.

As mentioned, electromagnetic waves propagate far, infinitely far in airless space, but they are quickly attenuated. And they are dampened and absorbed by what they encounter, even by moisture in the air. (The higher the frequency, the faster they weaken by distance.)

When exposure from a radiating source is calculated, it is normally done based on ideal situations where there are no dampening and no reflective or absorbing objects other than human tissue. The calculations are mostly based on *the radiation's heating potential*, which for such equipment and situations being the topic in this book – AMS meters and other electronic equipment in the home – is negligible in all relevant situations.

However, the waves can spread much further than the theoretical calculations indicate, since the calculations are mostly made presupposing an idealised situation with waves from only one antenna, and where the signal is only sent out through the air and continues through that medium:

By “*contagion*” onto the wiring network, electromagnetic radiation can reach much further. Such “contagion” may occur by *induction*:

Induction is a fundamental electrical phenomenon. When an electromagnetic wave hits a material that conducts current, for example a metal object or a wire, an electrical current is “transferred” or

“evoked” or “applied” or “brought forward” – *induced* for short – in the material. The electrical current produced causes new electromagnetic waves to be emitted.

Through induction into well-conducting materials, electromagnetic waves can therefore reach much further than the just “airborne” electromagnetic waves will do. E.g., a transmitter placed close to a wire could cause the wireless radio signals to be reproduced also in the wiring – through induction – which means dirty electricity. In turn, the wiring sends the signals out into the wire's electric field, the wire working as an antenna. So, if the wiring runs along or inside walls throughout the home, the radio signal will be found throughout that home.

Through induction, electromagnetic radiation will also easily be passed on from one area to another via any electrically conductive object forming a “bridge” between the two fields, e.g. the coil springs in the mattress in a bed, which then pass the radiation on. This is exemplified in Figure 27: A charger (here a mobile charger) sends pulses out into the electrical wiring and also from a wireless transmitter (here a WiFi router) pulses of various frequencies are induced in the electrical wiring. The pulses then travel further around in the house, the wires acting as antennas. The pulses will then be induced in the spiral springs in the mattress, which send them out. The person in the bed will therefore be exposed from many angles.

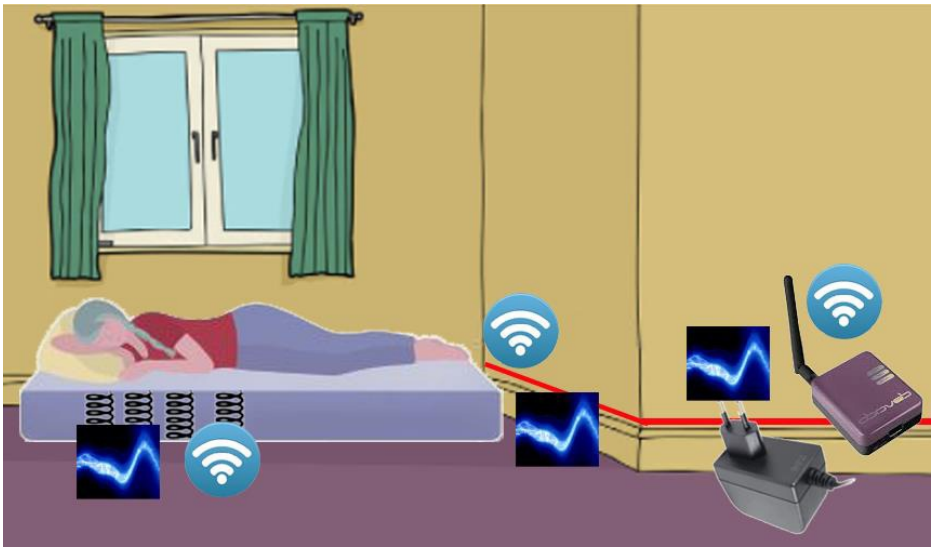

Figure 27: Example of induction (illustration: Else Nordhagen)

Induction is thus a “mechanism”, so to speak, by which of electromagnetic radiation may reach far out, whether through wiring or through the air, and then continue the spread through any next step of induction.

Electromagnetic radiation from one location in a home may thus travel through the power grid over very long distances (kilometres), emanating its signals all the way.

Such inducted radiation may be directly measurable over considerable distances, not only from power lines, but also from e.g., broadcast transmitters. Or consequences for health might be indicated *indirectly* in *epidemiological studies*:

Statistical correlations have been demonstrated between the use of coil spring mattresses, the prevalence of FM transmitters and breast cancer. The hypothesis supported by the statistical findings is that the development of FM transmitters contributed not only to an increased incidence of *malignant melanoma* (malignant mole cancer), but also to an increased incidence of *breast cancer* on the side where radiation induced from the springs will be focused – around 30 cm above the mattress, which is the location of the left breast, since most people sleep on the right side:

Ref. 146: Örjan Hallberg, Paavo Huttunen and Olle Johansson: Cancer incidence vs. Population Average Sleep Duration on Spring Mattresses, Advanced Studies in Medical Sciences, Vol. 2, 2014, no. 1, 1 – 15, http://dx.doi.org/10.12988/asms.2014.3810

Correspondingly, it has been found that when the wavelengths are so short that they *resonate* in the sweat ducts in the skin, as may do "millimetre waves" now being increasingly used in applications for the mass market, the spiral sweat ducts may act as antennas forwarding the radiation further into the body. So, the radiation is not stopped by the skin, as was assumed in the engineering circles designing such communication technology, therefore considering it to have no harmful health impacts:

Ref. 147: Anna Kochnev, Noa Betzalel, Paul Ben Ishai and Yuri Feldman: Human sweat ducts as helical antennas in the sub-THz frequency range-an overview, Terahertz Science and Technology,,ISSN 1941-7411 Vol.11, No.2, June 2018, Invited Paper.

Such pulses that are created under such circumstances are sometimes referred to as *Brillouin precursors*. They have the property that they penetrate deeply, also into organic tissue, without being absorbed as easily as less sharply pulsed energy.

Ref. 148: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, Chapter 14 Brillouin precursors, https://bit.ly/3QoQ2qW*

One may speculate as to what happens to the energy from the transmitter when an AMS meter is inside the fuse box, i.e. inside a metal box where the wires to the house are located: Will this metal box reflect the radiation, and will it function as a *Faraday cage*, a box where electric fields do not easily penetrate in or out? If so, one might presume that the fuse box contributes to increasing the radiation inside the box, in which case the result might be increased induction in the electrical wiring. The pulses from the dirty electricity in the electronics and power supply – and possibly the transmitter module – would then be spread more easily around the house via the mains.

Or maybe the fuse box will act as an antenna, or both? How the effects will actually be in each individual case may be hard to predict.

3.8 Interaction between several sources: Interference, "hotspots"

Here, the complexity of electromagnetic fields are exemplified in real situations. Major technical consequences are shown.

The more sources and the more frequencies there are in its surroundings, the more complex the energy fields at any specific location become, and the greater the chances are for various forms of interference (mutual influence/interaction) to occur.

Two basic forms of interference are *constructive interference and destructive interference*. They are shown simplified in Figure 28 as A and B respectively: (A) shows that the two waves are added when they are in the same phase, i.e. synchronous, and that they neutralise each other – cancel each other out – (B), when they are in opposite phases. (C) and (D) show more complicated combinations.

Explanations and examples as to radio technology interference are often unrealistically simplified, such as in Figure 28 and in Figure 20. Figure 29 gives a slightly more realistic picture of interference in practice: Interference between waves from several sources, here drops in a water

* https://www.safertechnology.co.nz/wp-content/uploads/2021/04/ELECTROSMOG-May-2021.pdf
We relate to the Norwegian edition: Susan Pockett: Stråletåka – Helse- og miljøforurensningen fra mikrobølgene, 237 pages, Z-forlag, 2020, ISBN 978-82-93187-50-9.

pond. In the meetings between the waves, constructive and destructive interference and hotspots occur in a rather unpredictable pattern. Hitting land, a reflection occurs, which further complicates the picture.

In realistic situations in a city, or e.g. in a block of flats with many dimmers, LED bulbs, AMS meters, reflection from opposite buildings and building parts, etc., there will be many sources – with corresponding opportunities for interference. Small, very local *hotspots* may also arise.

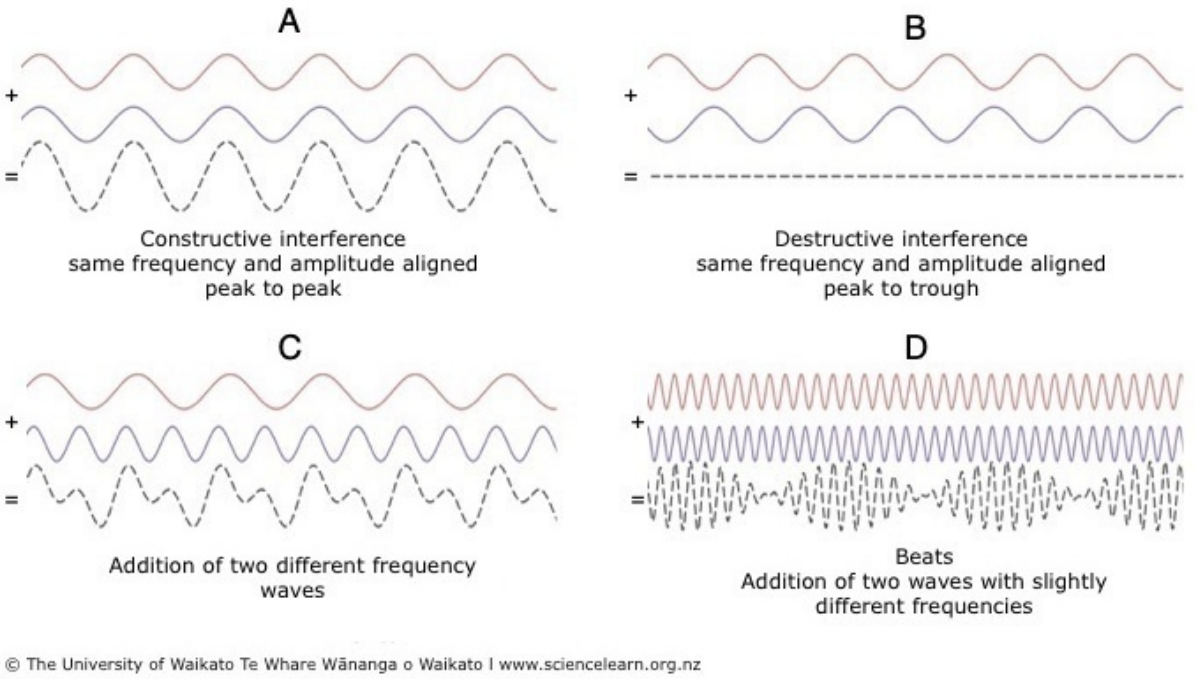

Figure 28: Different forms of interference
(source: University of Waikato, NZ)

With more sources and harmonics added to the picture, the pattern becomes more realistic, but far more complicated. There will be chances for stronger impacts, and not the least many unknown pulses and frequencies. The patterns also becomes unpredictable. In such real life situations, you will not be able to predict, map or make measurements which can tell in advance the outcomes of interference.

If you wish to reduce interference in such situations, you will in practice need a stepwise approach – identify by measurements the sources that emit the strongest radiation, and then remove or shield them. Or you might do what is more realistic for most people: remove the sources you control yourself, like transformers, LED lights, dimmers, etc., and try to shield or distance yourself from the rest, as the strongest radiation is not necessarily the most annoying one.

An AMS meter, and in principle any other electronic component attached to the mains, represents a potential source of radio waves and/or dirty electricity that might interfere in unpredictable ways with other sources inside and outside the home. All such sources cannot be easily removed, neither may they all do any significant harm.

Figure 29: Constructive and destructive interference from several sources. Here drops in water illustrate the complexity of waves interfering to create "hotspots" and reflections. (Photo: Else Nordhagen 2019)

3.9 Transmitting information requires electromagnetic pulses

Here it is explained how information transmission via radio is physically based on pulsations and corresponds to what is called dirty electricity in the context of electricity wiring.

There are several ways to encode information onto radio waves. For digital communication, such as in the case of AMS meters, *pulse modulation* is used. The information is then coded in the form of pulses, i.e. sudden energy shifts in the electromagnetic field. These pulses come at certain frequencies that vary according to the different coding techniques used. The frequencies of the pulses are determined by the communication standard used (WiFi, 4G, Zigbee, etc.) and by what data is sent at any given time.

A communication standard specifies three types of frequencies:

1. One is the frequency of the radio waves used, called *the fundamental frequency of the carrier wave*.
2. The second frequency is the *pulse rate*, which indicates the "number of pulse slots per second". A pulse slot can be filled with a pulse or be silent, corresponding to the transmission of the digital information 1 or 0.
3. In addition, most technologies have a *fixed frequency* for a *call sign,* or *beacon signal*, that allows devices in the wireless network to stay in touch and contact each other whenever they want. This is the third type of frequency. In Figure 24, we have seen that WiFi has a 10 Hz beacon signal.

All devices in the same wireless network use the same carrier frequency(/ies). The frequency use is standardised by the industry's or intergovernmental standards organisations, and regulated and controlled by the national authorities. Certain frequencies are unregulated, i.e. for free use. Others are licenced.

Furthermore, the pulse frequency and the beacon signal are absolutely essential for the devices to be able to communicate with each other, so these too are strictly standardised – not by the authorities, but by the industry – through so-called “industry standards”, or through technical solutions that are specific to a manufacturer. For example, the AMS meter manufacturer Aidon has chosen to transmit a beacon signal every approx. 0.6 seconds around the clock, i.e. a continuous, intermittent signal.

The variations in pulse frequencies within a certain type of wireless network are therefore created by the data transmitted – others than these strictly standardised and predictable signals. The variations created by the data transmitted will depend on its content and is therefore largely stochastic – i.e. *random and unpredictable*.

With an oscilloscope, an (analogue) carrier wave without information will be seen as identical, smooth waves of sinusoidal shape. See Figure 30: At the top of the figure, there is an idealised representation of a carrier wave as it would appear if it were sent continuously – without any added information. Below is an idealised representation of pulses (also named *pulsations* as there are several pulses in each burst). You see that each pulse may contain one or more waves, and that there is a pause between each pulse that encodes the information: The carrier wave is not sent, because it is not needed, as is the case in a radar signal, or because the difference between the burst and the silence has a meaning to the transmission system or to the receiver of the message.

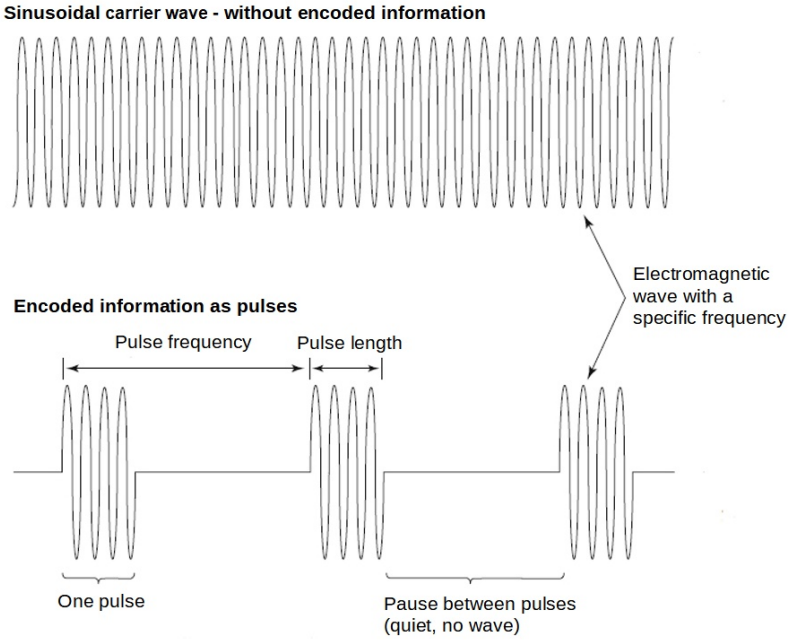

Figure 30: Idealised representation of a carrier wave (top) and idealised representation of pulses providing some information content (bottom).

(Content in radio signalling is normally encoded by varying the frequency of the carrier wave (FM, frequency modulation) or the amplitude (height) of the waves (AM, amplitude modulation). The deviations from the carrier wave provide the content to be extracted at the receiving end.)From the lower part of Figure 30, we understand that any calculation of exposure based on average intensity (seen here as the height of the amplitude) over time will be strongly influenced by the many breaks: The *average exposure* will be very low. Therefore, evaluated by such a measure, the radiation will be considered very weak, even if the pulses are very strong and regular. ICNIRP uses time averages as the method of calculation to identify the potential for health impacts. With many transmitters in

our surroundings, we have around us a cacophony of different signals consisting of a variety of fundamental frequencies, lower pulse frequencies, harmonics and frequencies resulting from interference. Figure 31 shows a practical situation in a Norwegian city – Stavanger:

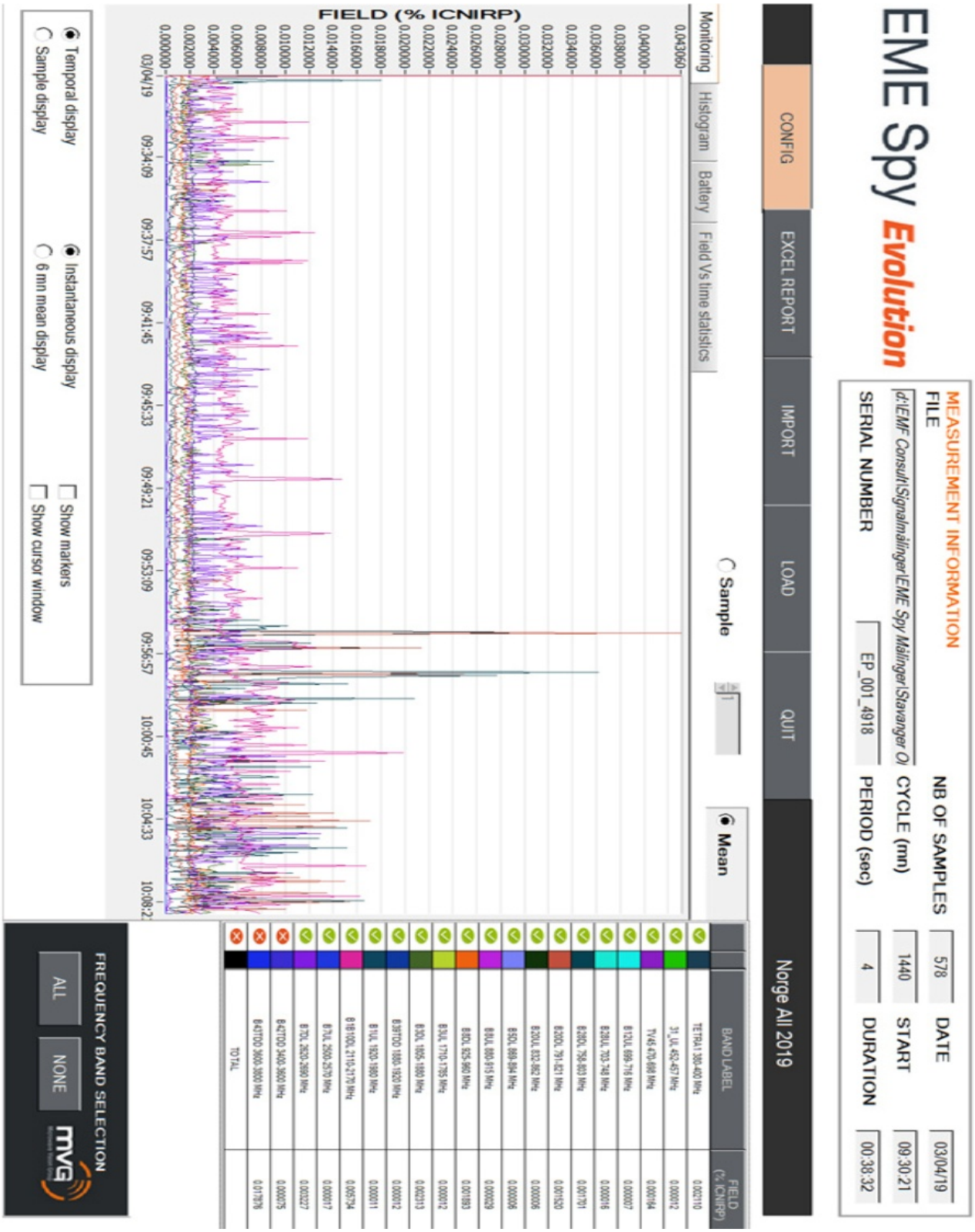

Figure 31: Frequencies and signal strengths measured in Stavanger, as percent of ICNIRP's guideline values (measurement: EMF-Consult AS)

We see a lot of different signals at different frequencies coming from various sources (listed to the right) in the surroundings. The different carrier waves are indicated by different colours. The registration has been done over approx. 40 minutes (horizontal axis). The vertical axis shows the intensity (the “strength” of the radiation) as a percentage of ICNIRP's guideline values for protection against heating damage: We see that based on such a measurement, the radiation is negligible.

The pulses with the highest energy are seen as the highest spikes. We also see that if you search for patterns, you will probably find a number of repeating pulse patterns.

To look for repeating pulse frequencies, Fourier analysis is used. Such an analysis is shown in Figure 26 above, and in Figures 27 and 28 in

> Ref. 149: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, Part 2, https://bit.ly/3BI97h3*

In Ref. 149, you may see that certain specific frequencies found to change the permeability of collagen molecules, thus affecting the metabolism and the neurons' signalling, were found in 4G mobile signalling. It would be highly astonishing if those same frequencies are not frequently found in other microwave signalling as a result of the information being sent. The biological impact from such frequencies are found even at extremely low intensities, and the pulses have a very high penetrating power (as do Brillouin precursors, see section 3.7 above), and Ref. 149, pp. 99 – 111, where more literature references are given.

3.10 Digital radio – abrupt, short pulses and bursts

Here it is explained in more detail how information transmission via radio is linked to pulsation and dirty electricity, and how newer technologies cause greater problems.

Newer digital wireless communication technology makes use of very abrupt and strong energy shifts. They often take the form of very short pulses or bursts of pulses with pauses in between. Such a design provides fast transfer of large amounts of data. (Figure 32)

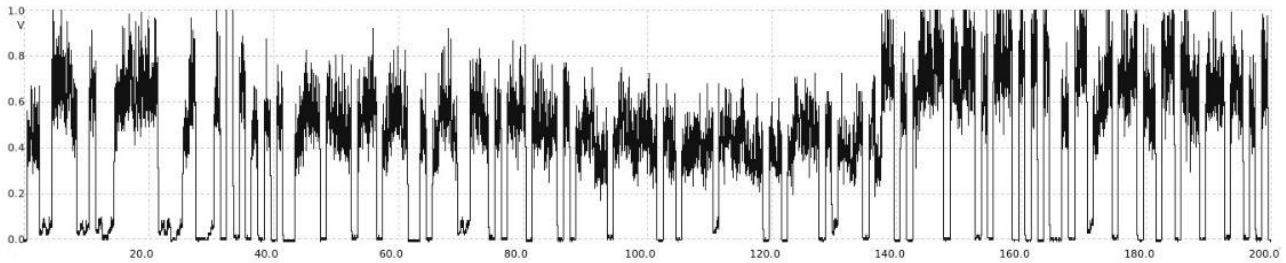

Figure 32: LTE, i.e. 4G communication from mobile towers.
Horizontal axis: time. Vertical: intensity. (Measurement: Kim Horsevad)

We see that because of all the breaks in information transmission, the average intensity is far lower than the pulse peaks.

A usual way of measuring the difference between the amount of energy in the pulse peaks vs. the average amount of energy in the radiation over time is the *PAPR* (*Peak to Average Power Ratio*), or *Crest factor*: This is used to express the energy difference mathematically by a value.

* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

Figure 33 shows the difference between average and pulse peaks as a red double arrow. The blue bars show pulses. The highest pulses have the highest energy ("Peak"). The dashed line indicates the average energy over time ("Avg" stands for "Average").

The PAPR (i.e. the Crest-factor) is intentionally increased when developing ever new generations of radio communication: A higher Crest factor increases the amount of data that can be transmitted over time and distance. It is therefore to be expected that PAPR (and Crest-factor) will continue to grow in the future, unless regulated.

This means that we are in the middle of a development where pulses are getting closer and more abrupt to make room for more information to be transmitted.

We believe it is right to assume that the communication technologies in today's AMS meters are characterised by far more powerful, abrupt pulses than previous communication technologies, and so also for the electronics within them. We guess that these are the reasons why we see that AMS meters evoke such strong biological reactions in some people. We have no specific numbers or measurements done to support this belief, but some support is though found in an analysis of a series of electricity meters of different make and age, finding – roughly speaking – more dirty electricity and higher peaks the newer the meters:

> Ref. 149b: EMF Consult AS, Hjortland, OM: Test of Conducted Emission ("Dirty Electricity") From Different Generations Of Electricity Meters, rev. April 2022, with introduction by Einar Flydal and Else Nordhagen: "Dirty power" from new electricity meters: Key to a health problem?, PDF note, https://bit.ly/3wrRrDF*

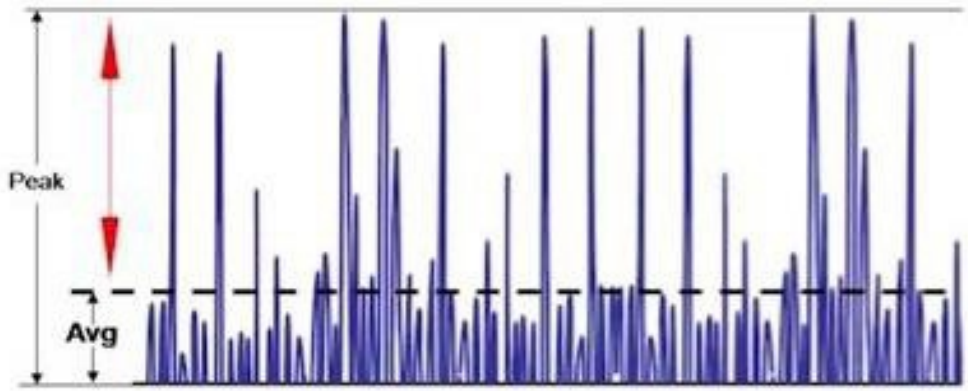

Figure 33: PAPR (Peak to Average Power Ratio), or "Crest-factor" indicated as a red arrow.

Biosystems have, through the evolutionary process, been developed to make use of a great diversity of electromagnetic pulses and variations created by nature. See e.g.

> Ref. 150: Zaporozhan, V., & Ponomarenko, A. (2010). Mechanisms of Geomagnetic Field Influence on Gene Expression using Influenza as a Model System: Basics of Physical Epidemiology. International journal of environmental research and public health, 7(3), 938–965. https://bit.ly/3HaaLu8†

This also applies to very weak pulses from weather fronts. For a comprehensive bibliography, see

* Full link: https://einarflydal.com/?smd_process_download=1&download_id=73602

† Full link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2872305/

Ref. 151: Hans Baumer and Walter Sönning: The natural impulse frequency spectrum of the atmosphere (CD-Sferics a. t. B.) and its biological reality, 2002 (47 pages, unpublished, PDF, https://bit.ly/3WDWzPZ*

Walter Sönning, a medical meteorologist, together with Hans Baumer mapped such pulse patterns from weather systems and their impact on biological material. Sönning has long since retired. He told the authors (personal emails) that he and his colleagues had to stop doing research in this field after URSI – the UN International Union of Radio Science – proclaimed funding should cease for this entire research field in the 1980s. At the time, methods to create filters against atmospheric noise had been developed. Also, it had become increasingly clear that there was a conflict between this field's research results – being on the one hand that weak low frequency pulses from nature play a significant biological role and that biological systems could therefore easily be disturbed from man-made pulses, and, on the other hand, that fact that radio communication generating such pulses was becoming ripe for massive deployment in the consumer market.

Sönning expresses great concern that the development of radio communication is constantly moving in the direction of signals mimicking the pulses from nature that life uses as control signals.

Ref. 152: Sönning, Walter: Weather Sensitivity and Electro-sensitivity, Research Report, Kompetenzinitiative e. V., 2013, https://bit.ly/3wtmMGd†

Ref. 153: Private emails to Einar Flydal, 2017 -2021

Sönning states that this development in such signalling creates incremental, but profound changes in life's conditions and will therefore necessarily affect many species, including humans, with various kinds of health problems and illnesses or other effects resulting from habitat destruction.

Several researchers working within this field express similar concerns related to the pulses' similarities to nature’s pulses, as well as to the fact that life is also disturbed by other aspects of EMFs where human use of EMFs mimics nature's regulatory systems. For example, the biologist Ulrich Warnke and several other biologists claim that they have long seen such effects reflected in species loss: The species most dependent on using EMFs to orient themselves, to hunt, etc., seem to be the first to loose out and go extinct.

Here are a few relatively easily accessible sources with many further references:

Ref. 154: Warnke, Ulrich: Bees, birds and mankind – Destroying Nature by 'Electrosmog', Kompetenzinitiative e. V, 2009, https://bit.ly/3XTVpRp‡

Ref. 155: Panagopoulos, Dimitris J. & Balmori, Alfonso: On the biophysical mechanism of sensing atmospheric discharges by living organisms, Sci Total Environ. 2017 Dec 1;599-600:2026-2034. doi:10.1016/j.scitotenv.2017.05.089.

Ref. 156: Rothkaelhl H, Izohkina N, Prutensky I, Pulinets S, Parrot M, Lizunov G, Blecki J and Stanislawska I: Ionospheric disturbances generated by different natural processes and by human activity in Earth plasma environment, Annals of geophysics, Supplement to Vol. 47, N. 2/3, 2004

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* German only. Original title: “Das natürliche Impuls-Frequenzspektrum der Atmosphäre (CD-Sferics a.t.B.) und seine biologische Wirksamkeit” Full link: https://einarflydal.com/wp-content/uploads/2017/03/baumersc3b6nning-das-natc3bcrliche-impuls-frequenzspektrum-der-athmosphc3a4re2002.pdf

† Full link: https://kompetenzinitiative.com/wp-content/uploads/2019/08/ki_fb_soenning_wetterfuehligkeit_okt13.pdf

‡ (Also in German) Full link: www.naturalscience.org/wp-content/uploads/2015/01/kompetenzinitiative-ev_study_bees-birds-and-mankind_04-08_english.pdf

3.11 Dirty electricity – unknown pulse frequencies, pulse lengths, strength and PAPR

Here it is detailed a little more how dirty electricity and radio communication are highly unpredictable in terms of interference – both technically and biologically.

Wireless communication is strictly regulated by the authorities and highly standardised. It is therefore possible to assess the properties of the electromagnetic field in relation to several parameters traditionally considered to be important, such as carrier frequency, pulse frequencies, beacon signal frequencies, max. output power and PAPR. One may thus draw a picture of the electromagnetic properties of any wireless network and its transmitters.

The frequencies formed by pulses that encode information, on the other hand, are far less predictable: They depend on the information being transmitted.

An important reason for regulation and standardization is precisely the wish to avoid disturbances (interference) between different wireless technologies. On the other hand, such regulations provide loop holes at areas not considered of particular importance – or where the resistance against regulations have been particularly strong.

Also dirty electricity relates to regulations or standards, but to lesser extent: For example, there are no EMC regulations for dirty electricity at frequencies lower than 150 kHz. However, a number of frequencies well proven to have biophysical effects, are lower than 150 kHz, e.g. frequencies that change the permeability of the collagen molecule and thus affect metabolism, nerve signalling, etc. Some of these are at 4, 6, 8, 10, 12 and 28 kHz (in part a harmonic row), and were well researched in Germany during the 1960 – 1980s: Such pulses appear in nature and were studied since they caused substantial problems in modern printing industry. Emanating from weather fronts, they made the etching processes, in which collagen was used, dependant on weather fronts far away. These studies not only provided an explanation to *weather sickness*, appearing before any changes in the weather, but also to *EHS – electro-hypersensitivity* as a kind of “digital weather sickness”.

Since their research lost funding in the 1980s, the one remaining central scientist from the German research team, Walter Sönning, has been warning against the consequences on biology from mass production of such pulses in wireless communication and digital technologies in general, through his many summaries of complex scientific knowledge of the field, like this one:

> Ref. 157: Walter Sönning: “Mobile telephony and the natural impulse radiation of the atmosphere: A fundamental critique of exposure limits”, 2021, unpublished PDF note, https://bit.ly/3wroDv8*

With no EMC regulations for dirty electricity at frequencies lower than 150 kHz, dirty electricity with biophysically active components might easily pass the European CE and other certifications and might pollute the electricity mains with any carrier frequencies, pulse frequencies and intensities and any composed pulses (by constructive interference), to name just a few examples of possible varieties.

It is impossible to predict the presence and characteristics of the dirty electricity in any detail apart from the most evident when typical sources are connected, like LED lamps, dimmers, motors, converters, equipment with transformers (SMPS) and the like. One must measure and even so it is hard to tell if there are patterns present which would have an impact or not. When faced with several simultaneous radio sources interfering with each other, it becomes practically impossible to

* Original title: “Der Mobilfunk und die natürliche Impulsstrahlung der Atmosphäre: Eine grundsätzliche Grenzwertkritik”, full link: https://einarflydal.com/wp-content/uploads/2023/01/117-Sonning-W-2021-Die-Evolution-und-5G.pdf

predict anything of relevance about the electromagnetic conditions in a house, at a seat or a bed. It has to be measured – and measured time and over when changes are made as to what is connected, switched on or off in the house, even in the immediate surroundings. The complexity is therefore too large for most people to deal with, and also unreasonably large for specialists. Only fragments of its complexity have been studied.

3.12 Dirty electricity creates significant societal problems

More or less dirty electricity is now found everywhere in the grid and in most homes. It is acknowledged as a serious technical issue. We have mentioned several examples of technical sources. Here are a few examples as to how the problem of dirty electricity is a comprehensive problem – not only to individual households or individuals, but to society as a whole.

In recent years, modern households have gradually acquired more sources of dirty electricity, and these may individually or together create problems through various kinds of interference.

Solar panels cause major problems in that they, through dirty electricity, create strong electro-magnetic signals that *interfere with licensed wireless communications*. Dirty electricity from solar panels may emit radiation on the same frequencies as mobile phones and illegally interfere with the licensed frequencies of the defence, telecom companies and the civil aviation authorities:

> Ref. 158: “Why the solar cells disturb”, Elinstallatören (a Swedish publication for electrical installers), 4. May 2020, https://bit.ly/3RlViw1 (our translation from Swedish):*
>
> “EMC, electromagnetic compatibility, is a product's ability to function in its environment without emitting unacceptable interference. Before 2019, the Swedish Safety Agency never received any complaints about EMC problems from solar power installations. But last year, ten reports suddenly appeared from different places in the country. Further, a number of people made contact by email and phone. ... Apart from Telia, it is mainly radio amateurs who have suddenly had a problem after neighbours – or they themselves – have installed solar cells [panels] on the roof of houses. ... In some cases, the disturbances are relatively strong, despite the fact that the solar cell installation is several hundred meters away. All registered facilities have a common denominator. They have optimizers, a component causing the electricity production not to drop that much when some of the panels enter the shade. ... Both optimizers and inverters may be potential sources of interference. Optimizers contain DC/DC converters, while inverters have DC/AC converters. It is well known that such switched power electronics may give rise to voltage disturbances.
>
> The crux of a solar cell installation is that the voltage disturbances can spread to the long haul DC cables, which in turn can act as accidental transmitter antennas. They may send out undamaged radio signals on frequency bands used by mobile operators and the defence, as well as by radio amateurs and broadcast radio.
>
> Some components spread interference although complying with current EMC standards. ... Another difficulty is that the EMC labs test one product at a time, while a solar “farm” may have tens of optimizers. The total disturbance may therefore be significantly higher.”

The technical standards are not suitable for preventing harmful interference from solar cell electricity converters on vital infrastructure:

* Swedish original: “Därför stör solcellerna”, full link: https://www.elinstallatoren.se/2020/05/darfor-stor-solcellerna/

> Ref. 159: “Per-Ove was forced to demount the solar cells: "They disturb"”, El-installatören, 04 May 2020, https://bit.ly/3DdeXYQ (our translation from Swedish):*
>
> “- The problem is that the manufacturers have declared their products according to an EMC standard which is not really particularly suitable for solar cell products, says Henrik Olsson. ... Mobile operators, the [Swedish] Armed Forces, the Civil Aviation Authority and radio amateurs – are complaining more and more about disturbing solar cells. ... He flips through an email from the Armed Forces, which explains that products on the Swedish market do cause radio interference: "The radio interference is primarily due to the antenna loop that is formed during installation between the solar panels, optimizers/microinverters and/or inverters."”

Radio noise from solar power panels may disrupt mobile communication:

> Ref. 160: “Telia: "No doubt that the solar cells spread disturbances"”, El-installatören, 4. May 2020, https://bit.ly/3wxTZ3k†
>
> “Telia's measurements show that at that site, there is radio interference which appears in the early morning and subsides at dusk. During the dark hours of the day, it disappears completely. ... Mobile network manager at Telia: He describes the situation as worrying. – We have been assigned these radio frequencies to be able to operate the mobile network in a safe manner with high quality for customers. “The disturbances in Mörby are not a one-off event. In the future, this will happen many places, and a solution is needed.” These frequencies must absolutely not be disturbed.”

Radio noise from solar panels may disrupt radio communication for airplanes:

> Ref. 161: Luftfartsverket: “No solar cells within 3 km, thank you”, El-installatören, 4. May 2020, https://bit.ly/3Hc5geE‡
>
> “Solar cells may interfere with aircraft radios, according to the [Swedish] Civil Aviation Authority, which wants a protective distance. – Our frequencies are classified as crucial. The Civil Aviation Authority, LFV, is worried about the expansion of solar cell installations. This is what the authority wrote at the beginning of March in an information letter to 17 Swedish airports: “It is currently clear that interference from solar energy installations may have a harmful effect on air traffic control radios”. Therefore, the authority wants to see a protective distance of three kilometres between solar cell installations and aviation air traffic control systems.”

Electricity charging systems for electric cars and other uses of electricity in households also create strong dirty electricity, while an expert who addresses the topic, gets criticized for doing so:

> Ref. 162: “I received criticism when I said that electric vehicles spread disturbances on the electricity grid”, El-installatören, 07 January 2020, https://bit.ly/3kGzDSO§

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* Swedish original: “Per-Ove tvingades ta ner solcellerna: ”De stör””, full link: https://www.elinstallatoren.se/2020/05/per-ove-tvingades-ta-ner-solcellerna-de-stor/

† (Swedish) title: “Ingen tvekan att solcellerna sprider störningar”, full link: https://www.elinstallatoren.se/2020/05/telia-ingen-tvekan-att-solcellerna-sprider-storningar/

‡ (Swedish) title: “Luftfartsverket: Inga solceller inom 3 km, tack”, https://www.elinstallatoren.se/2020/05/luftfartsverket-inga-solceller-inom-3-km-tack/

§ (Swedish) title: “Jag fick kritik när jag sa att elfordon sprider störningar på elnätet“, https://www.elinstallatoren.se/2020/01/jag-fick-kritik-nar-jag-sa-att-elfordon-sprider-storningar-pa-elnatet/

> “Electricity quality expert Donald Andersson was rebuffed when he singled out electric vehicles as sources of interference. Now he says that the problems are increasing – and not only from electric vehicles. … But I absolutely think the disruption problems are escalating. Harmonics are not only emitted from electric cars, but also from bad LED drivers, solar panels and heat pumps. The harmonics are then fed into the electrical system, says Donald Andersson”

Unforeseen interference problems created by dirty electricity have become an important field of scientific research:

> Ref. 163: “Sarah knows why hair dryers start in the middle of the night”, El-installatören, 27 March 2017, https://bit.ly/3Dh3nfy*

> “New electronic devices cause new disturbances to which the electricity grid must handle. The researchers in Skellefteå find out how. ... Take, for example, a family which installs solar cells on the roof of their house and an electric car charger in the garage. They connect the inverter of the solar cells to one of the house's phases, just like many house owners do. Then the voltage on that phase raises when the sun comes out, and the panels start producing electricity. But what happens if the family simultaneously plugs in the electric car for charging on a different phase? And the neighbour does the same? And the neighbour's neighbour, too? If the imbalance becomes high enough, other equipment connected to the power grid may be damaged.”

Harmonics from electric cars may trigger fires in TVs, stereo systems, etc.:

> Ref. 164: “Overtones from electric cars forgotten risk for the TV set and fixtures: "May catch fire"”, El-installatören, March 12, 2020, https://bit.ly/3XF5dyX†

> “Electrical engineer Lars Hoffman at the electric car manufacturer Nevs talks about how multiples of 50 hertz find their way to capacitors in, for example, luminaires, stereo systems and televisions. …”

Modern electronics, with rectifiers and chargers, destroy the quality of the electrical power in the grid by creating distortions, i.a. voltage harmonics:

> Ref. 165: Lindberg, Maria: Electricity quality and disturbances in connection with charging the municipality's electric buses at the charging points Röbäck and Carlshöjd, Thesis for MSc in energy technology, civic engineering, Umeå University, May 2016, (Abstract in English), https://bit.ly/3WFhTob‡

> “A good power quality is a concept concerning the technical quality of an electric power delivery. It is also a prerequisite for electronics connected to the grid to work as expected. The devices connected to the Swedish power grid was for a long time of a resistive sort, but a strong development towards more sophisticated electronics is creating new demands for the power grid. Modern electronics are emitting more distortions, and are simultaneously more vulnerable to distortions.

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* (Swedish) title: “Sarah vet varför hårtorkar startar mitt i natten”, https://www.elinstallatoren.se/2017/03/sarah-vet-varfor-hartorkar-startar-mitt-i-natten/

† (Swedish) title: Övertoner från elbilar bortglömd risk för tv:n och armaturer: “Kan fatta eld”, https://www.elinstallatoren.se/2020/03/overtoner-fran-elbilar-bortglomd-risk-for-tvn-och-armaturer-kan-fatta-eld/

‡ (Swedish) title: “Elkvalitet och störningar i samband med laddning av kommunens elbussar på laddningsplatserna Röbäck och Carlshöjd”, www.diva-portal.org/smash/get/diva2:932580/FULLTEXT01.pdf

> Non-sinusoidal loads generate distortions on the power grid they are connected to. The rectifier is such an electrical load, which above all is generating harmonic currents. The harmonics occur in the current waveform and spread upwards in the power grid, with the risk of getting caught in transformers and thus create an abnormal thermal heating in the transformer windings. The current harmonics are transmitted to the voltage according to Ohm's law, and are titled voltage harmonics. These tend to spread downwards in the power grid, affecting other electrical loads close by."

Also hospitals have problems with dirty electricity interfering with the various devices and instruments they use:

> Ref. 166: "EMC problems in hospitals: "Nursing staff have probably gotten used to it"", Elinstallatören, 03 November 2017, https://bit.ly/3j658VR*
>
> "The risk of measuring equipment being disturbed seems present everywhere, but unfortunately does not receive much attention. One reason is probably that the healthcare staff has become accustomed to the problems and resort to different tricks to deal with them. They might unplug the cord for the bed lift, move a light, or ask the patient to hold their hand on the metal bed frame. It also seems common that examinations have to be made over again. This increases the workload and costs a lot of money, says Martin Lundmark. ... Hospitals use increasingly better and more sensitive instruments. But since many measuring equipment are very high-impedance, even small interfering voltages deviating from the standard mains voltage may cause troublesome disturbances. The supplier does indeed test its products, but the tests are done in a lab and not in real life in the hospitals among all the devices out there. In addition, hospitals are increasingly using energy-efficient technology which, among other things, "hacks up" the mains voltage and thereby creates disturbances. These are, for example, speed-controlled lifts and fans, chargers for phones and energy-saving light fixtures, says Martin Lundmark."

It is thus clear that there are endless sources of dirty electricity in our modern world. In particular are many of the "green technologies" significant sources of dirty electricity.

Some sources may be strong, other may be much weaker, but depending on the location and conditions in the surroundings, also these weak sources may be both amplified and the distortions spread over large distances. AMS meters may be considered such weaker sources. Due to their central location in the fuse box with connections to all the mains circuits, as well as other conditions present in the house, they may diffuse the dirty electricity in the EMFs over the entire house, thereby amplifying the problem.

In the striving to cope with climate and other environmental challenges, more electricity production from "green sources" and the use of electricity saving "green technologies" are favoured and stimulated. The problems with dirty electricity seem forgotten or unknown – both as to their impacts on technology, as well as to their impacts on biology.

3.13 The need to reduce radiation and dirty electricity has been known for a long time

Radio frequency radiation as well as dirty electricity may be reduced through a number of technical measures.

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* (Swedish) title: "Vårdpersonalen har nog vant sig", https://www.elinstallatoren.se/2017/11/emc-problem-pa-sjukhus-vardpersonalen-har-nog-vant-sig/

Generally, the most effective measures as to radiation from radio transmitters, are to *remove the source*, *reduce the power* (so called “effect”), *shield against exposure* with various materials (lead plates, graphite paint, textiles made of silver or steel wire, etc.), and *increase the distance* to the source.

But dirty electricity, and thus also the radiation in the electric field, may be reduced or removed by a number of other measures. First of all, equipment should be designed with a view to reducing dirty electricity, instead of removing it afterwards, which is both more expensive and more difficult. Mostly, measures will simply not be taken since so few people have any knowledge of the issue, nor the competence to do anything about it.

Measures to reduce dirty electricity through product design and production are not discussed further here. It is a topic for industrial designers and EMC specialists.

Some measures may take place when designing homes or during conversions. The Swedish National Board of Housing, Building and Planning, Boverket, produced in 1998 a series of eminent practical and detailed studies into what could be done to reduce dirty electricity from the domestic mains. These studies were later withdrawn from distribution – possibly as a consequence of the ICNIRP guidelines which were published that same year: According to these guidelines (see Ref.20) there could not be found any health issues from such weak and low frequency EMFs. Later, in 2004, WHO chose to define EHS (electro-hypersensitivity) as symptoms with no confirmed connection to EMFs, i.e. most probably a psychological or psychiatric phenomenon (see Chapter 2.10).

However, we got PDF copies of these four publications – which are in Swedish only – from the Boverket's archive, but no right to make them available for download. They might be read at https://bit.ly/3R8dlFy* or requested through your library, or directly from Boverket (registraturen@boverket.se). These publications are (titles translated to English):

> Ref. 167: Improved electrical environment in new construction – Furiren 3 at Kristianstad†. (PDF) BOVERKET 1998, ISBN 91-7147-497-8. 36 pages
>
> “SUMMARY: What can a building contractor who wants to build homes with an indoor environment that is shielded to best advantage from the effects of electrical installations do to achieve this? What technical measures are necessary and what costs are involved?
>
> A building company that has created a healthy and environmentally adapted residential area, by amongst other things restricting the electric fields, is the municipal housing company, AB Kristianstadsbyggen. The building project has been followed by the Institute of Building Economics at the Lund Institute of Technology, and their findings are presented in this report.”
>
> Ref. 168: Good electrical environment from the start – Experiences from the consulting industry‡. (PDF) BOVERKET 1998, ISBN 91-7147-481-1, 34 pages
>
> (Reports on what it takes to plan and build while reducing the EMFs from the mains by design from the start. The report points at the lack of knowledge about EMFs and effects of the living environment in all professions within the building industry. It concludes that extra costs are low, but could be substantially lower if larger demand. Some specific technical advices are given as to the electrical wiring system, grounding and shielding.)

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* Full link: https://einarflydal.com/les-svenske-boverkets-utgatte-veiledninger-om-el-miljo-i-boliger-her/

† Swedish title: Förbättrad elmiljö vid nybyggnad – Furiren 3 i Kristianstad

‡ Swedish title: God elmiljö från början – Erfarenheter från konsultbranschen

Ref. 169: Improved electrical environment – measures to reduce electric and magnetic fields in homes*. BOVERKET 1998, ISBN 91-7147-503-6. 44 pages

"SUMMARY: The report entitled "An Improved Electrical Environment" contains examples of electrical decontamination where residents have experienced that conditions have improved. The report describes the technical measures taken in order to reduce the electrical and magnetic fields. In addition to these examples, there is an appraisal of different technical measures, terminology and concepts. The report also contains a section in which the National Board of Health and Welfare provides a short account of the sensitivity to electricity concept.

The publication is a part of the National Board of Housing, Building and Planning's series of publications on "Build for Health and the Environment"."

Ref. 170: Comprehensive electrical remediation – Measures to reduce electric and magnetic fields in homes†. (PDF) BOVERKET 1998, ISBN 91-7147-508-7. 40 pages

"SUMMARY: The report focused on conditions for those who are hypersensitive to electricity. A clear-cut conclusion to their problems cannot be drawn, since the causes of hypersensitivity vary. Certain people can cope with low-frequency, but not high frequency fields, while others can cope with magnetic fields but not electrical, or vice versa.

In about thirty interviews recorded after electrical decontamination for hypersensitive residents had been carried out, the findings of the report indicate that, amongst other things, there are considerable variations in the degrees of help and support provided by employers, municipalities, regional social insurance offices and health care services. The study shows that in nearly all cases the living environment works well after decontamination, but also points out the need for the municipalities to have similar procedures to deal with subsidy applications for electrical decontamination."

We have found a few other Scandinavian publications as to how to reduce electrical fields, radiation and dirty electricity. Two examples are mentioned here, in Norwegian and Swedish only:

Ref. 171: EMF Consult AS: EMF Protection – Electromagnetic fields and radiation – What you should know, and what you can do?, PDF, EMF Consult AS. In rev. 03.2, 2019, see pages 30 – 37, https://bit.ly/3kKz22q‡

Ref. 172: Forshufvud, Ragnar: Housing and Health, a practical handbook for a healthier home§, editor: Mimers brunn, 1998.

NB! This book does not cover dirty electricity from modern electronic equipment. Additional notes to the book must be included for more up-to-date information:
http://www.eloverkanslig.se/pdfer/Komplement_Bostad-Halsa.pdf

Among non-Scandinavian sources for literature on practical measures to avoid dirty electricity, we just mention the EHTrust web site, where some sources might be found, and the comprehensive list of studies and reports found at the site of the producer of dirty electricity filters, Stetzer electric:

Ref. 173: https://ehtrust.org/?s=dirty+electricity

* Swedish title: Förbättrad elmiljö – åtgärder för att minska elektriska och magnetiska fält i bostäder

† Swedish title: Omfattande elsanering – Åtgärder för att minska elektriska och magnetiska fält i bostäder

‡ Norwegian title: EMF Beskyttelse - Elektromagnetiske felt og stråling - Hva bør du vite, og hva kan du gjøre?, full link: https://emf-consult.com/wp-content/uploads/2020/07/E-bok-EMF-Beskyttelse-rev-03.2.pdf

§ Swedish title: Bostad och hälsa, en praktisk handbok för ett sundare hem

Ref. 173b: https://www.stetzerelectric.com/research/

A book on juridical aspects of electrical hazards, with comprehensive explanations, but with no examples as to the more subtle biological workings of dirty electricity, is:

Ref. 174: Leslie A. Geddes & Rebecca A. Roeder: Handbook of Electrical Hazards and Accidents, second edition, Lawyers & Judges Publishing Company, Inc., 2006 [eg. p. 24]

This book highlights, among other things, accidents caused by *double-insulated electrical equipment* without earthing, *grounding faults* and *poor grounding* as important reasons for why dirty electricity from large or small sources, from milking machines in the barn to modern electronics in the home, which is not routed away, may lead to *health problems*.

4. Electrical systems in homes, EMF, dirty electricity, AMS meters and filtering

In this section we will – with an emphasis on the technical aspects – go through:

- how electrical installations create electric and magnetic fields
- how electric and magnetic fields create electrical currents that run through the body
- the phenomenon of *noise voltages* on the mains, of which there are several different types
- what the *sources* of noise voltages are
- how modern electrical equipment, including AMS meters (automated metering systems for electricity), creates a lot of noise voltages (also called, *dirty electricity*)
- how *the lack of shielding in today's wiring in domestic houses and noise voltages separately and combined increase the power of electric fields*
- *exposure limits and standards* for such electrical noise – i.e. for EMC (Electromagnetic Compatibility)
- *measurements* done of the noise voltages on Aidon and Kamstrup AMS meters, and test results
- the extent to which *biological effects* are to be expected

There is some overlap in this part with the content of Part 3. Hence, this part may be read as a more independent “technical” part.

4.1 Electrical installations have electric and magnetic fields

The electrical system in a home is normally a source of radiated electric, magnetic and electromagnetic fields. These fields are areas around wires and electrical devices where everything within the area, including people, is exposed to, and affected by, electric and magnetic forces. The three different fields may be described separately, but their impact is as a whole.

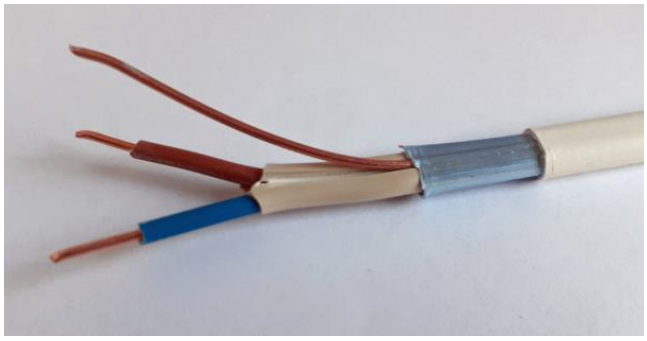


Figure 34: Shielded cable with grounding wire (copper) and an aluminium shielding sheath.

Such cables are used where electrical cables are installed visibly, typically along skirting boards. They may also be used as a fix to re-place the normally unshielded cables used in plastic pipes hidden in walls.

The most common electrical installations in modern housebuilding consists of unshielded single conductors (PN) hidden in the walls in plastic pipes. This contributes to the electric fields becoming extra strong. Open electrical installations on the outside of the wall are done with shielded cables (PR), see Figure 34. They tend to have a somewhat lower electric field if the protective sheath/copper wire in the cables is connected to ground (which is often not the case).

Electric and magnetic fields create weak electric currents and fields in the body through induction and capacitance. This may easily be demonstrated and measured.

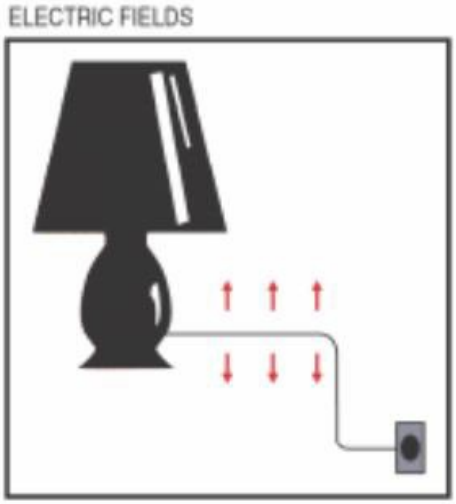
Ref. 175: EXTREMELY LOW FREQUENCY FIELDS, Environmental Health Criteria 238, WHO, 2007, https://bit.ly/3Y7vtB*

- Induction is defined as the creation of electric current in a conductor by the influence of a magnetic field, or from electric current flowing in an other conductor. A well-known example is the operation of an induction furnace, where the alternating electric currents in the spool wound around the furnace create “eddy currents” that melt the metal in the furnace.
- Capacitance is a term for the ability of an electrical system or conducting body to absorb, i.e. "build up", an electrical charge.

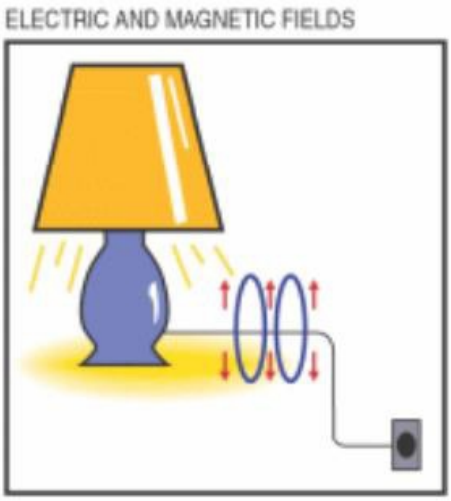
4.1.1 Electric and magnetic fields

Figure 34B shows that electric fields are created as long as power is connected, even when the appliance is switched OFF. So, an electrical appliance connected to the mains will be surrounded by an electric field even when the appliance is switched off and no current is flowing through it.

Magnetic fields are only present when electrical current flows in the wires, i.e. when the device is switched ON. When current flows in the wire, both electric fields and magnetic fields are present.



The appliance is switched OFF. Electric fields are created.



The appliance is switched ON. Magnetic fields are present when there is flow.

Figure 34b: Electric fields arise where there is voltage, and magnetic fields when there is current flowing (illustrations: unknown)

Electric fields occur where there are voltage differences, such as between the two plates in Figure 34C – the one at the top and the other at the bottom. Accordingly, there are electric fields around all wires being “live”, i.e. connected to electrical current. The strength of the field increases as the voltage increases.

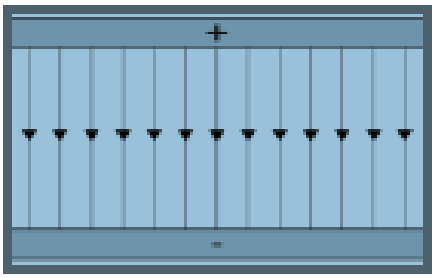


Figure 34c: Two plates of different voltage create an electric field

*Full link: https://apps.who.int/iris/rest/bitstreams/51837/retrieve

Electric fields are measured in Volts per metre (V/m). – Electric fields can relatively easily be shielded.

Magnetic fields occur when electrical charges in a conductor (e.g. a wire) are in motion, i.e. current flows in the wire. This is illustrated in Fig. 34D: When electricity flows from + towards -, i.e. in direction I, the magnetic field B occurs.

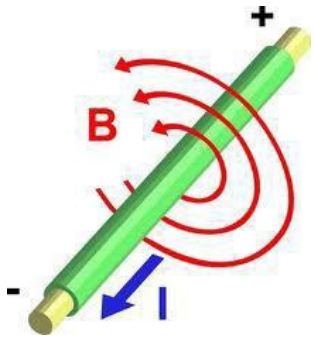


Figure 34d: When electricity flows, a magnetic field B is created

The size of the magnetic field depends on the strength of the electrical current. Hence, the field increases when the current through the conductor increases. For appliances that are switched off, there is therefore no magnetic field.

Magnetic fields are measured in tesla (T). This is a so-called “large unit”. Therefore it is common to specify magnetic fields in *micro-* or *nanoTesla* (µT or nT). Magnetic fields pass through most materials and are relatively difficult and expensive to shield.

Shielding of magnetic fields must be done with specific metal sheets and casing. A text about a practical case of magnetic field shielding is described in detail in Ref. 176.

> Ref. 176: Flydal, E: This is how we removed the magnetic field from the power cable, blog post 02.03.2018 (Norwegian), https://bit.ly/3XJTRtq*

As understandable from the text above, there are electric and magnetic fields around all wires in the home. In these fields, there will often be significant amounts of relatively high-frequency electrical noise, which can increase the fields' ability to create electrical currents in the body. Such noise is part of what is referred to here in this book as “dirty electricity”. (Also, this noise gives by itself rise to an electromagnetic field around the wires, as described in Chapter 3.)

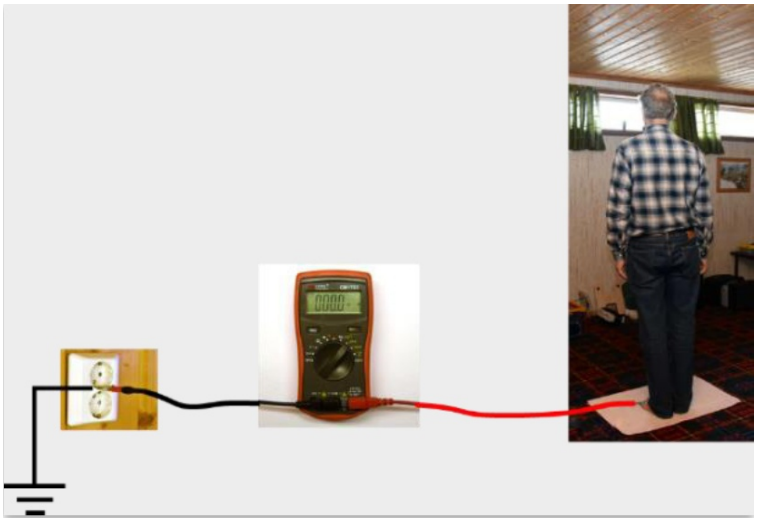


Figure 35: Measurement set-up to find current induced through the body

(From experiments carried out by professional electronics engineer Jostein Ravndal)

When measuring the electric fields in a normal home, it is not uncommon to find fields with a strength of 60 V/m (volts per meter) in living areas.

If a person stays in such a field, it will normally be found that there is an electrical current with a strength of approx. 0.6 µA (microamps) through the person’s body and to ground. In Figure 35, we see a setup that shows how a multimeter may be used to measure the current passing through the body: You measure between the metal plate and the ground connection of the electrical wall socket.

* Norwegian title: “Slik fikk vi vekk magnetfeltet fra strømkabelen”, full link: https://einarflydal.com/2018/03/02/slik-fikk-vi-vekk-magnetfeltet-fra-stromkabelen/

The stronger the field in which you stay, the more electrical current will pass through your body.

In our (European) power grid, the electrical current switches its direction 50 times per second (50Hz). Hence, all connected equipment will create larger or smaller, more or less abrupt, voltage changes, i.e. electrical noise. The higher the frequency of these switches, the more current will pass through the body:

Hence, the ability of the electric and magnetic fields to generate currents in the body increases proportionally to the frequency. This means that *even relatively weak electrical noise can contribute to more electrical current passing through the body, if only this noise has a high frequency*:

> Ref. 177: Frank de Vocht and Robert G. Olsen: Systematic Review of the Exposure Assessment and Epidemiology of High-Frequency Voltage Transients, Front. Public Health, 29 March 2016, https://doi.org/10.3389/fpubh.2016.00052
>
> "The fact that the frequencies are "higher" is relevant, because at ELF [Extra Low Frequencies], the amplitudes of both capacitively coupled currents and magnetically induced voltages are proportional to the frequency. Consequently, *higher frequency fields with smaller amplitudes can create the same voltages and/or currents as lower frequency fields with larger amplitudes*." [Highlighted by us.]

In an ordinary home there may be many sources of magnetic fields. Everywhere a lot of electricity is used, e.g. for heating water, strong magnetic fields may be found. Older type single-conductor (floor) heating cables may be a significant source. Electric stoves are also sources of strong magnetic fields.

The magnetic fields will generate currents in the body, and *stronger currents are created the higher the noise frequencies in the electric and magnetic field*. The strength of the magnetic field is the same inside the body as at the outside of it. Therefore, magnetic fields are extra problematic. Still, they receive little attention as a cause behind health and environmental problems.

4.2 The influence from the electric and magnetic fields

Most people do not think they are affected by the electric, magnetic or electromagnetic fields present in every room in their home. It is easy to think like this: – We have used electricity for over 100 years, so why should such fields suddenly become a problem?

These fields from electrical installations are not a new health problem, but the electromagnetic environment in today's homes has actually become much worse than in the past. Two main reasons are we have much larger electrical installations now than before and we use more electricity. We have several sockets in each room and in today's homes we prefer dimmable downlights almost all over. Which means more wires in walls and ceilings, and more electrical noise.

While in the infancy of electricity – and in Norway until the 1960s – cables were laid in metal pipes which shielded close to 100%. Today mainly unshielded wire (PN) is used, threaded in plastic pipes in walls and ceilings. These create a much stronger electric field than the metal tubes and shielded cables (PR) previously used. In any normal home today, there are therefore significant amounts of electric, magnetic and electromagnetic fields, and they immerse the entire home.

Previously, only 230V IT IT (Isolated earth) systems were installed in Norway. Today, 400V TN systems are installed. TN (Combined earth and neutral) systems have higher voltage and therefore stronger electric, magnetic and electromagnetic fields. In addition, TN systems often lead to *vagrant currents (*also called *stray currents)*, electrical currents travelling along other paths than intended,

such as “leakage current” travelling along water pipes and the like. Such vagrant currents can be the origin of significant magnetic fields throughout the home and in the outdoor areas around the home.

The Danish biologist Kim Horsevad has found vagrant, or stray, currents with high noise frequencies to cause significant problems at Danish farms:

> Ref. 177b: Horsevad, Kim: Analysis of Stray Current, its Aetiology, Propagation, Relevant Measurement Protocols and Mitigative Efforts at a Pig Farm in Northern Denmark. International Journal of Science and Research (IJSR), Volume 9 Issue 1, January 2020, ISSN: 2319-7064, https://bit.ly/3WNdGPa*

Also in Ref. Ref. 174 (Geddes & Roeder 2006, above), an example is given of vagrant currents causing significant harm, there to cattle. See also Stetzer’s papers for examples (Ref. 173B).

As to humans, it is well established medical knowledge that EMFs from power grids are associated with several health issues like ALS and lymphoma, that LFs (low frequencies) and ELFs (extra low frequencies) seem to be the significant active component when acute symptoms are seen – nearly irrespective of energy levels, and that pulsing is well established as a cause for serious disturbances at the cellular level. (Sources are found in later chapters.) So, together with the experiences told by EHS people, indications are more than strong that when electrical noise is added to the mains, and even as vagrant currents, chances are there is an increased health risk added.

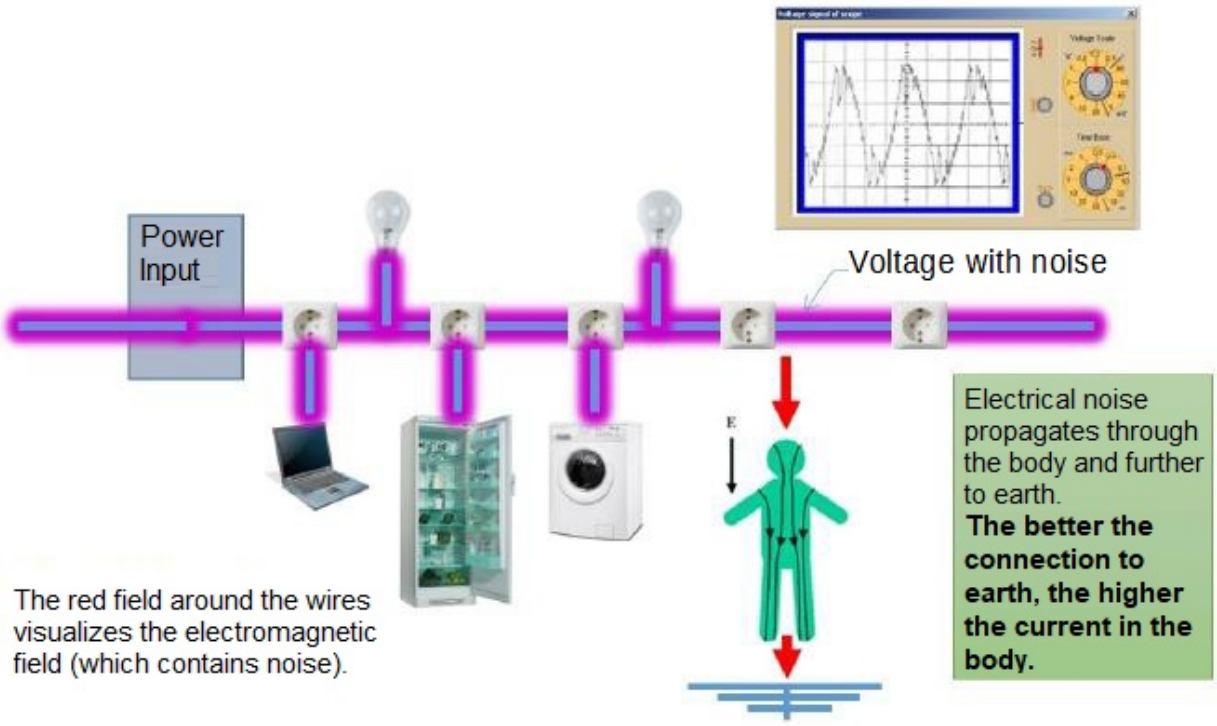


Figure 36: We are far more wired up than before, with wiring everywhere in the house. And it is less shielded. This situation creates stronger fields and more dirty electricity.

* Full link: https://www.ijsr.net/get_abstract.php?paper_id=ART20204317

4.3 Modern electrical equipment creates a lot of noise voltages

Together with more wiring and more electricity consumption, most people today have much more electrical equipment in their homes than before, and they have electrical equipment that creates a lot of noise in the network, not the least due to SMPS's (switch mode power supplies), which create thousands of pulses per second, i.e. frequencies in the kHz range.

Such frequencies are high compared to the 50 Hz of the mains (or 60 Hz in USA), but still considered LF or VLF, Low or Very Low Frequencies, within the context of the EMF frequency spectrum range 0Hz – 300GHz. Frequencies in the kHz range and lower are exactly in the range linked to biological reactions demonstrated by the German research on impacts on collagen from the particular atmospheric discharges called *CD sferics after Baumer,* mentioned above (see Ref. 157). They are also within the range disturbing cells' ion channels even at very low energy intensities, as shown by (Panagopoulos et al. 2021):

> Ref. 177c: Panagopoulos DJ, Karabarbounis A, Yakymenko I, Chrousos GP. Human-made electromagnetic fields: Ion forced oscillation and voltage-gated ion channel dysfunction, oxidative stress and DNA damage (Review). Int J Oncol. 2021 Nov;59(5):92. doi: 10.3892/ijo.2021.5272

All connected equipment makes noise on the electrical wiring, and some modern electronics make a lot of noise. In the home, it is challenging as the noise propagates throughout the electrical system, adding "high-frequency" components to the electric and electromagnetic fields around the wires.

This situation causes a complex and most unclear picture of radiation with biological damage potentials in the fields around the wiring in most homes, created by the many interfering sources of noise.

However, unlike an AMS meter, almost all of this equipment may be turned off and unplugged whenever you want to. In fact, there are a good number of people with very low electricity consumption, disconnecting the equipment whenever not in use, even having the refrigerator connected only a few hours per day. Many EHS people do so. In this way, they significantly reduce the amount of electrical noise emanating from the mains in their homes.

The fact that electrical noise on the mains may originate both from sources inside the home and from sources outside the home, adds one more dimension to the problem.

4.4 High-frequency noise voltages on the power grid

Modern electronics create large and high-frequency, highly varying noise voltages. In the following text on noise voltages, we also discuss noise filters, which may be used to remove or attenuate such noise voltages.

A main source of large and (relatively) high-frequency, highly varying *noise voltages* on the mains are *modern electronic power supplies* (SMPS, or switched mode power supplies) and similar mechanisms which extract power from the mains "in small, quick lumps". They do so to "transform" the AC (alternate current) in the mains into low voltage DC (direct current). With each such extraction, fast voltage shifts are created, hence also *sharp and short pulses* (*transients*).

Noise voltages, or *voltage noise*, is a variety of what is as a collective term more loosely labelled "dirty electricity" among electricity professionals. Noise voltages may normally be blocked or attenuated with a *noise filter*. More on this later in this section.

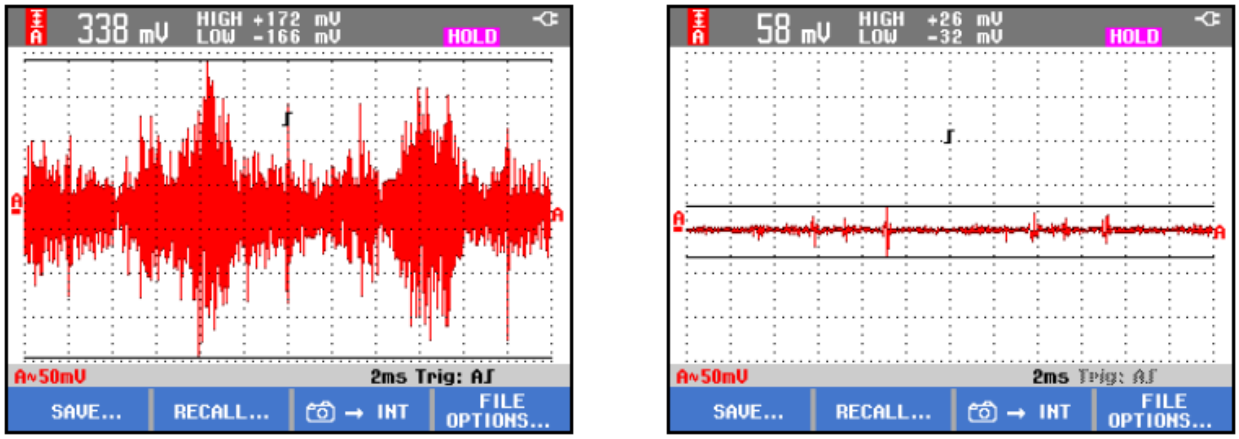


Figure 37: To the left: Voltage noise from an electrical device. To the right: Readings from the identical device after the noise is reduced by the installation of a noise filter. (Measurements: EMF Consult AS)

4.5 Different kinds of noise sources on the electricity grid

High-frequency noise and transients with frequencies above 50 Hz are called *voltage noise*, often also just “dirty electricity”, or *electromagnetic interference* (*EMI*). EMI is a collective term for a wide range of phenomena ranging from wired low-frequency noise to radio frequency noise (radiation) in the upper kHz, MHz or GHz range.

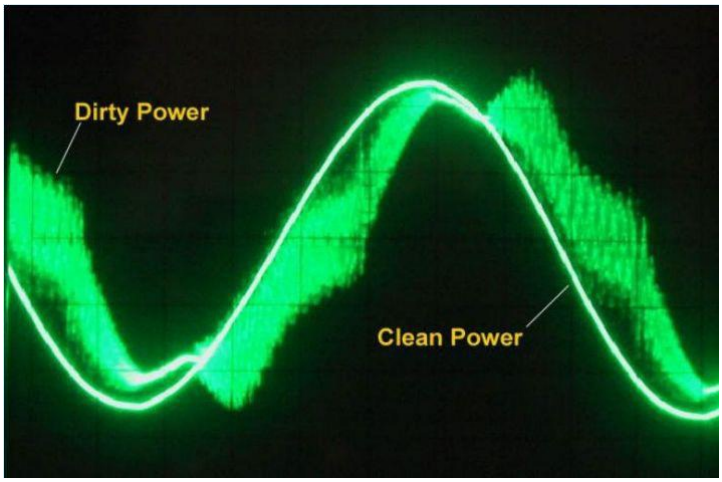


Figure 38: Dirty electricity and clean electricity on oscilloscope (Photo: Marcel Honsebeek, Electrosense)

Clean electrical current appears on an oscilloscope as a smooth and clean sinusoidal curve. Figure 38 shows both a clean sinusoidal curve from 50 Hz electrical current, and a superimposed reading – a bit offset – of a sinusoidal curve distorted by dirty electricity: Wire-bound noise changes the curve to a “shadow” created by much higher frequencies.

Figure 39 illustrates different forms of wire-bound noise that may occur on the power grid: Only the grid company can remedy shorter or longer power outages, frequency variations and low or high voltage. The other kinds of interference are noise that you may handle yourself with the use of noise filters and other measures.

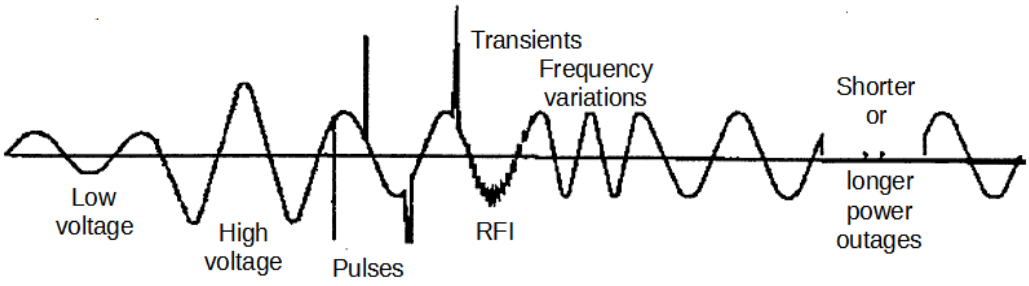


Figure 39: Different kinds of wired noise on the electricity network (source: unknown)

4.6 Pulses and transients

Pulses and *transients* are often used as terms for voltage noise with the following characteristics:

- Pulses and transients on the mains, i.e., the domestic wiring, can actually reach several hundreds, often more than 1,000 Volts. They are often "produced" locally, e.g. when equipment is turned ON/OFF ("bouncing"), or by a bad contact ("wobbly"), a motor starting, a fluorescent lamp lighting up, thermostats and relays snapping in, etc. Transients may also be caused by lightning strikes.
- A distinction is often made between *low-energy pulses* – which typically have an amplitude of less than 1,000 Volts with a duration of between 10 nanoseconds (nS) and 10 microseconds (µS), and *high-energy pulses*, which have an amplitude of more than 1,000 volts and a duration of more than 10 µS.
- Transients are voltage shifts and currents of short duration, typically less than half a wavelength and amplitudes higher than normal, then quickly dampened.

All these disturbances from pulses and transients will superimpose noise, either by adding to or subtracting energy from the nominal waveform, i.e. the sinusoidal curve, as shown in Fig. 39.

4.7 Induced radio frequency noise (RFI)

When voltage noise is created in the radio-frequency range, it is called *radio-frequency* (or *high frequency*) *interference* (*RFI*), hence a collective term for superimposed noise from a wide frequency range, from around 20 kHz to 300 GHz.

RFI may come about in many different ways. The culprits are often *brushed electric motors, radio and radar transmitters*, CD/DVD drives, switched mode power supplies (SMPS), high voltage lines, etc.

All electrical cables work as receiving antennas for radio signals. The electricity grid may therefore be understood as a giant receiving antenna leading radio signals directly onto the electrical wiring. A huge problem with RFI is that this kind of electrical noise *follows the shielding layers* of a cable (as exemplified in Fig. 34) as much as the conductors or the grounding, and radiates from there into the surroundings.

4.8 Harmonic noise

Normal linear loads

As long as the current draw (called the "load") is linear (i.e. steady), the current and voltage curve will both be perfectly sinusoidal.

Such loads would be resistors, coils and capacitances.

Also, sources such as heaters and ordinary incandescent lamps are typical examples of such a load. They are called *ohmic sources*, since they work by creating resistance.

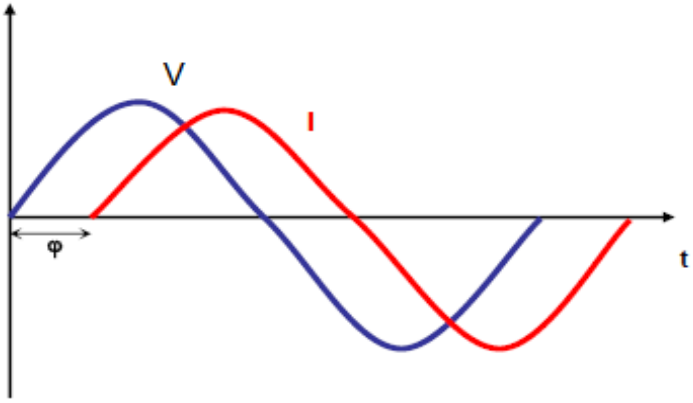


Figure 40: Current and voltage at an inductive linear load, where φ is the phase shift

Linear loads were the normal loads in the electricity grid until a couple of decades ago, when electrical equipment began to be developed to save electricity by "chopping up" the electricity, as we have mentioned that electronic chargers (SMPS's) and energy saving bulbs do. *Non-linear loads* then became a normal phenomenon.

Non-linear loads

By non-linear loads we mean the loads from equipment that does not produce pure sinusoidal currents.

Examples of such equipment are rectifiers, inverters, frequency converters and different types of lighting equipment.

In addition to drawing current at the fundamental frequency **f**, which is 50Hz (in Europe), currents will also be drawn at frequencies that are multiples of **f**. These are called *harmonic currents*, since they have frequencies forming the harmonics ("overtones") of the fundamental frequency.

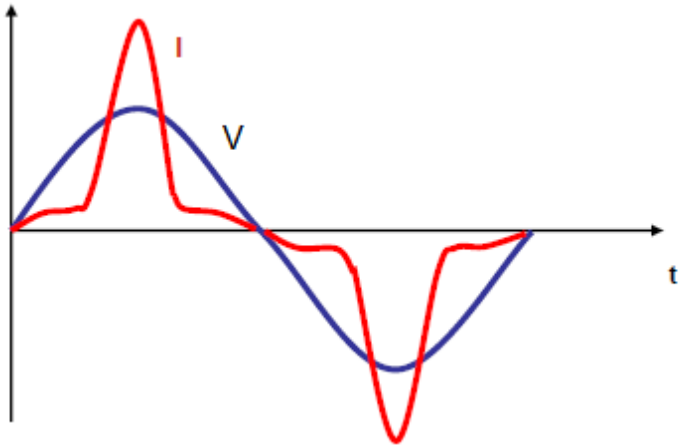


Figure 41: Example of current and voltage with non-linear loads

For physical loads, these will be *odd multiples* (the third harmonic, fifth harmonic, seventh harmonic, and so on.)

Harmonics

We define harmonics as voltages or currents with frequencies that are multiples of the fundamental frequency (50Hz). They are formed in the same way as acustic overtones, as in music.

The harmonic order in the European power grid is therefore 100 Hz, 150 Hz, 200 Hz, and so on.

Harmonic currents are able to:

- overload the N-conductor and hence produce stronger magnetic fields,
- cause malfunctions in sensitive equipment, overloading of capacitors, etc.
- lead to overloading, overheating and reduced performance of motors, transformers and generators,
- cause increased loss of electricity and hence increased consumption.

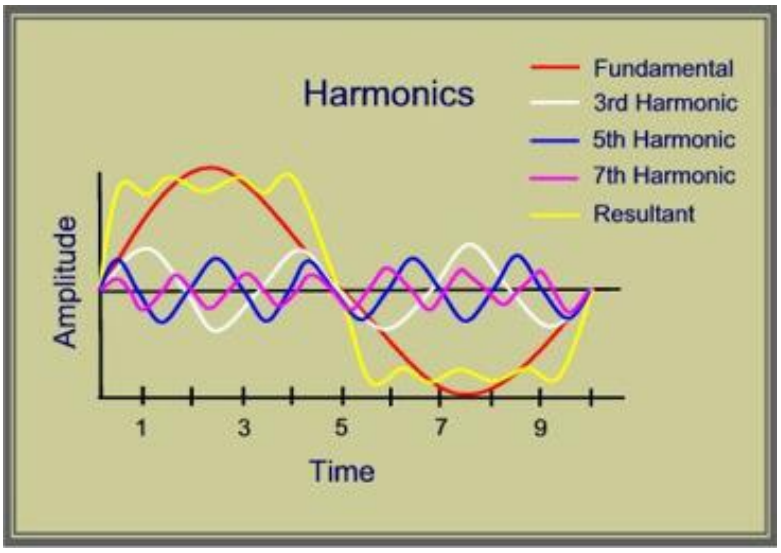


Figure 42: Harmonics – formed as in music (source: unknown)

Constructive interference

Each noise source emits noise in the form of more or less abrupt "waves". We draw them like this, even though they might look more like rhythmic "volleys of gunfire".

When two waves meet while they are both on a wave crest, the combined wave will – as shown in Fig. 43 – have a height corresponding to the two wave crests added: The two waves reinforce each other. We call this *constructive interference*.

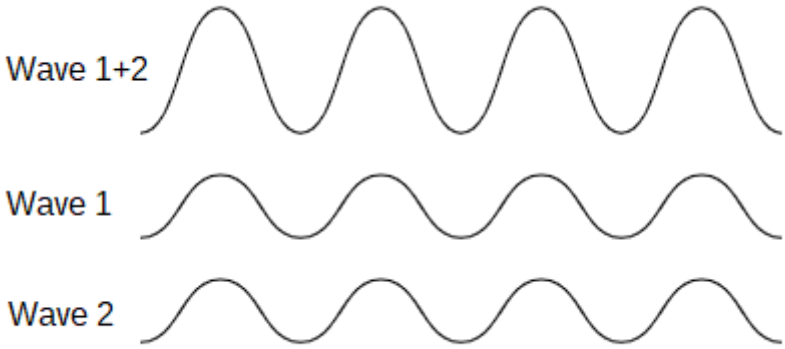


Figure 43: Constructive interference illustrated with two waves at the bottom and the resulting wave at the top.

In the case of constructive interference in the power grid, the intensity may become very high.

Problems with constructive interference often occur in installations where several identical power supplies with identical characteristics are used. It may occur by chance, with serious consequences, e.g. it may lead to transformers in the power grid burning up, or it may be discovered as a possible consequence as when, in the Netherlands in 2009, politicians spent around 150 000 GB£ to make Friesland "the most sustainable region in Europe" by converting to energy saving LED lightening:

Ref. 178: "The dark side of lightening", WaldNet, 26.3.2009, https://bit.ly/3RjvHnh*

* Original Dutch title: "De donkere zijde van led-verlichting", full link: https://www.waldnet.nl/script/show_nieuws.php/24481/De_donkere_zijde_van_ledverlichting.html?id=24481

The target was to sell 100,000 LED bulbs, all of which drew power in the same way, to customers in the area. In such a situation, explained an electrical engineer, the amplitudes – i.e. the strength of the compound signals – may become so strong that cables in the street heat up, computers malfunction, and transformer stations risk catching fire (because of the current in the N-conductor becoming too intense).

LED lights drawing electrical current simultaneously and at identical frequency may also create strong radio signals. This happened after the Rockheim museum in Trondheim was opened – with the facade covered in 13,000 LED lights. The LED lights disturbed the air traffic to and from Trondheim airport at Værnes by creating strong radio signals due to constructive interference, as shown in Figure 44.

> Ref. 178b: "This is how Rockheim blocked the flight communication", Adresseavisa 04.11.2013, https://bit.ly/3imSnWA†

You may experience both constructive and destructive interference and induced radio frequency noise in practice if you have a DAB radio running on battery at a location with poor coverage, just good enough for the radio to receive the DAB pulses and reproduce the radio broadcasts:

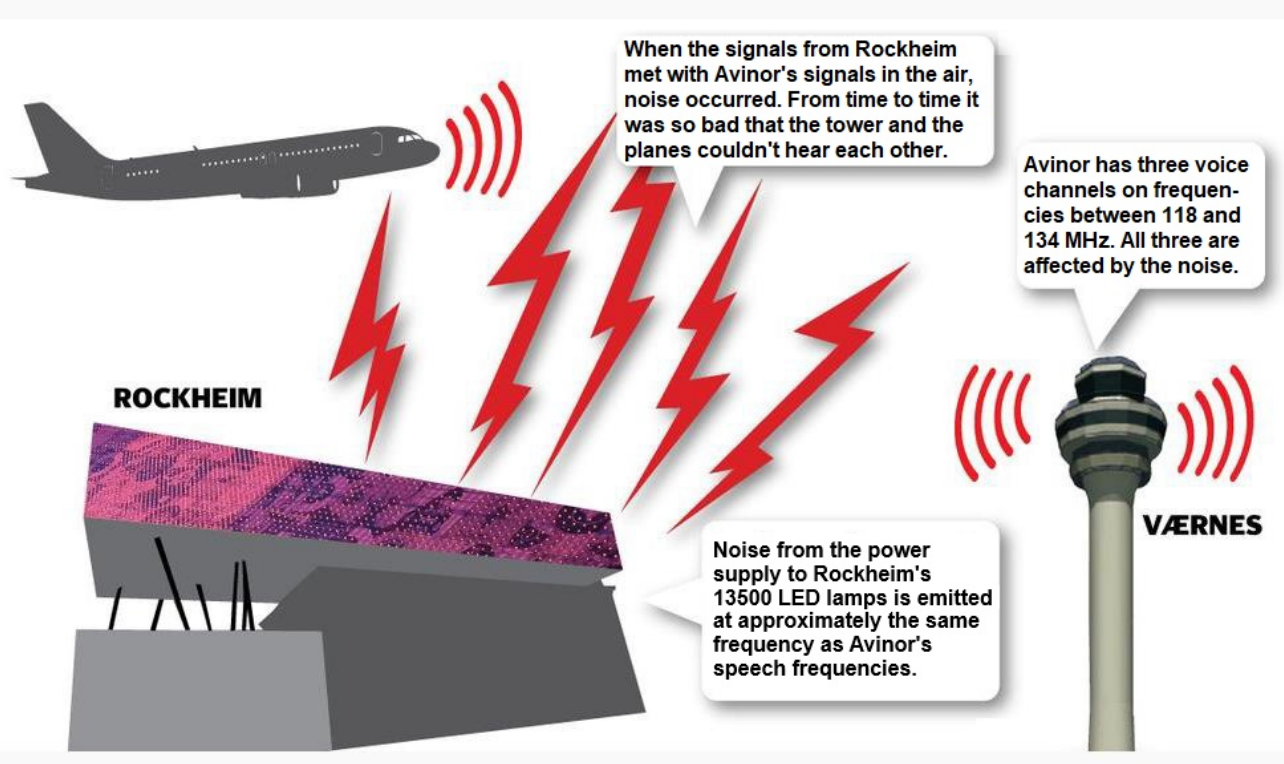


Figure 44: How LED lights at Rockheim disrupted air traffic (source: Adresseavisa 4.11.2013)

If you connect the radio to the mains with a charger that creates dirty electricity, the noise radiating from the wires will interfere with the DAB signal and distort the signal reaching the antenna. In addition, the noise radiating from the wires will be induced directly in the radio's antenna and thus captured as a radio signal that will mix with and interfere with the distorted DAB signal. Such disturbances can be enough to distort the pulses encoding the radio data to such an extent that the DAB radio goes silent.

† (Norwegian) newspaper article: "Slik blokkerte Rockheim for flykommunikasjonen", https://www.adressa.no/nyheter/trondheim/i/wO80Oo/slik-blokkerte-rockheim-for-flykommunikasjonen

It is well-known that also LED lights may create enough radio frequency noise to interfere with DAB radios, like a Rockheim problem in miniature.

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As stated earlier, the interference patterns will become very complex when waves from several transmitters mix. The more so when different frequencies from several noise producing devices are present on the same wiring. Even with just two sources, the pattern may get very complex:

If two sound waves of just *almost* the same frequency meet, a new and much lower pulsating frequency will be created as the amplitudes of the two signals converge at some fixed intervals, so that the lower frequency is created by constructive interference. The pulsating modulation of the amplitude will have the same frequency as the difference in frequency between the two sound waves:

A 120 Hz + a 100 Hz signal combined will therefore, by constructive interference, create a 20 Hz frequency. This is why church organs need no dedicated pipes to produce their lowest sounds!

Same goes for electromagnetic waves. Again we see that the patterns easily become extremely complex.

4.9 Exposure limits for electrical noise – EMC

All equipment manufacturers are obliged to ensure that the devices they produce, do comply with the exposure limits for electromagnetic radiation and cable-bound electrical noise. They ensure so through a self-declaration. Figure 47 provides an example.

For the consumer market, the European norm to comply with, is EN 55011:2009 class A Gr. 1. The manufacturer must issue a declaration of conformity stating that the device complies with this standard. The statement must be based on measurements carried out in a measurement laboratory.

As to measurements of *wire-bound electrical noise*, the manufacturer must demonstrate that he has controlled that the electrical noise is below the applicable exposure limits within the frequency range 150KHz – 30 MHz. The measurements must be filed and delivered to the control authorities on request. The frequency range 2 Hz – 150 kHz is unregulated.

EMC (Electro Magnetic Compatibility) is also called “electromagnetic coexistence”. EMC requirements must ensure that all electrical equipment has sufficient immunity and low enugh emission levels for devices not to interfere with each other, nor with itself. The requirements apply to the frequency range 150KHz – 30 MHz.
The norm EN 55011 consists of two classes:

A: equipment not used in private homes, and
B: equipment used in private homes.

While the equipment suppliers are obliged to ensure that their equipment complies with EMC requirements, the power grid suppliers (in Norway and probably in most other countries) are obliged to deliver the correct voltage to the home, in accordance with a quality norm for delivery, EN 50160.

EN 50160 applies to the frequency range 50Hz – 2kHz and is usually divided into two main areas:

- supply reliability (the availability of electric power)
- voltage quality (the applicability of electrical power).

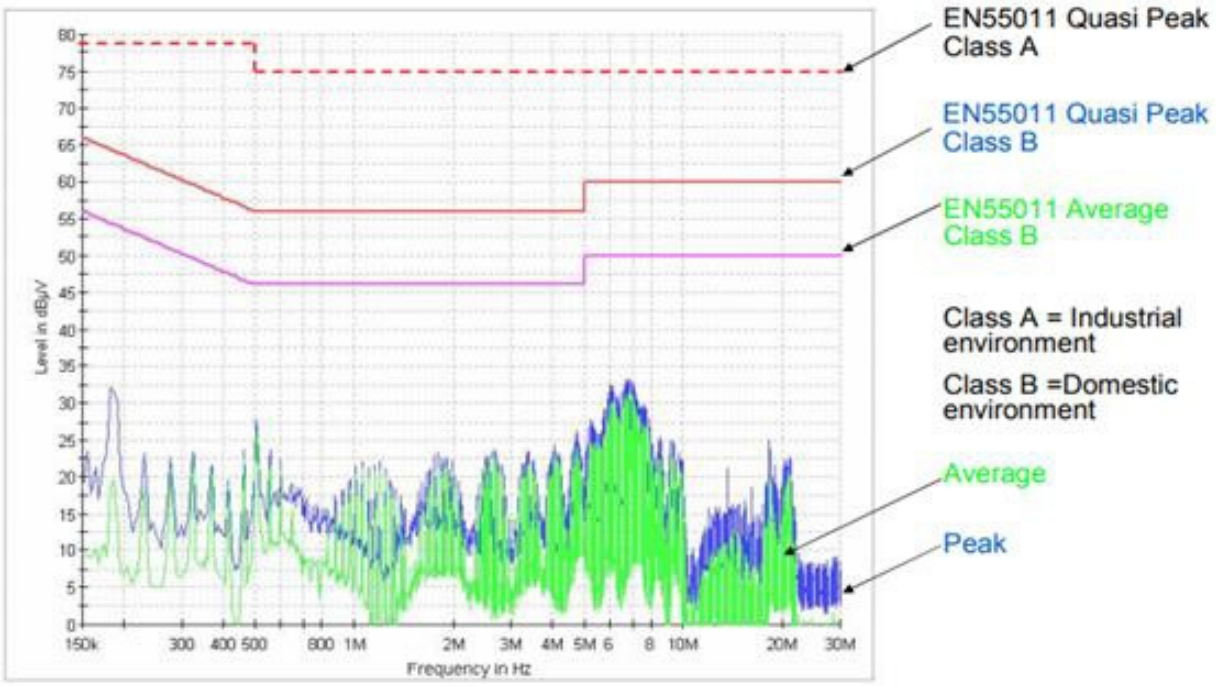

Figure 45: Example of noise measurement in the frequency range 150 kHz to 30 MHz. The exposure limits of the various standards are marked.

EMC and delivery quality shall primarily ensure that technical equipment works as intended and that it is not damaged. It is important to note here that the two standards used in relation to EMC and EMI, do not regulate EMI in the range 2 Hz – 150kHz nor frequencies above 30MHz. So these are grey areas, as marked in Figure 46.

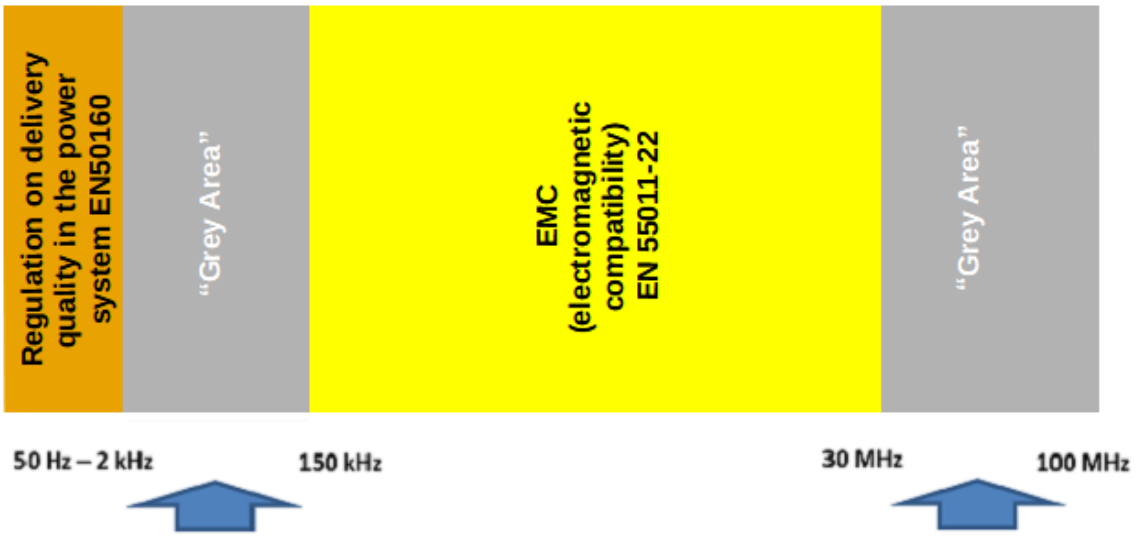

Figure 46: Apart from the frequency ranges that are regulated by EN standards, there are grey areas (shown by the arrows).

An example of a CE declaration is shown in Fig. 47, on the next page.

Aidon

EU Declaration of Conformity

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Manufacturer	Aidon Oy
Address	Piippukatu 11, 40100 Jyväskylä, Finland
Product type and model	Active Electrical Energy Meters, type Aidon 6560
Object of declaration	3-phase Active/Reactive Electrical Energy CT/VT Meter

The above-mentioned object is in conformity with relevant EU harmonization legislation:

Directive No. 2014/30/EU, EMCD
Directive No. 2011/65/EU, RoHS

Relevant harmonized standards and normative documents and references to the other technical specifications used for declaration:

EN 62052-11:2003
EN 62053-22:2003
EN 62053-24:2016
EN 50581:2012

Jyväskylä 17.12.2019

Tommi Blomberg
CEO Aidon Oy

Figure 47: Example of a CE declaration from the manufacturer that the product complies with the EU's technical requirements

4.10 Measurements of noise voltages from Aidon and Kamstrup AMS meters

The measurement consultant company EMF-Consult AS (http://emf-consult.no) had, on a regular consultancy basis for the initiative *We take the AMS meters to court!*[*], measurements carried out in Germany at the laboratory of Bajog, a leading manufacturer of measurement instruments.

The measurements were carried out in January 2021. They are available in full here:

> Ref. 179: Messbericht/Test Report (Aidon) 07/01/21, Bajog electronic GmbH, 2021,https://bit.ly/40dxZbA[†]
>
> Ref. 180: Messbericht/Test Report (Kamstrup) 07/01/21, Bajog electronic GmbH, 2021, https://bit.ly/3JsUMKx[‡]

Bajog's laboratory is not a laboratory certified for equipment certification, but serves the manufacturer of measuring equipment itself. The Bajog laboratory was chosen for the following reasons: Several Norwegian measurement laboratories we contacted, either backed out when they understood that they could come in conflict with authorities and with the electricity industry, or they would simply charge more than we could afford, or they told us they do nothing but certifications (which later turned out to be wrong).

In Figure 48 we see the exposure limits for wire-bound noise voltages for use in homes. The frequency ranges that are regulated through the norm, EN 55011 B Gr. 1 and 2, are indicated in the left column.

We had no access to the Kaifa/Nuri meters. Of the three main brands installed in Norwegian homes, therefore only Aidon and Kamstrup AMS meters were tested.

Emissions - Mains AC			
Frequency range	Limits	Basic Standard	Remarks
0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 dB (µV) QP 56 dB (µV) AV 56 dB (µV) QP 46 dB (µV) AV 60 dB (µV) QP 50 dB (µV) AV	EN 55011 Class B Gr. 1 u.2	Living area

Figure 48: The exposure limits for permitted cable-bound noise voltages for use in the home in accordance with EN 55011

Measurements of noise voltages from standard Aidon and Kamstrup AMS current meters show that they produce relatively large amounts of noise voltages in a very wide frequency range: 1 kHz to 50 MHz.

Below we emphasise and discuss several findings from the measurement reports.

*Norwegian name: *Vi tar AMS-målerne for retten!*, an initiative for a pilot case in court lead by one of the authors, Einar Flydal. By February 2023, the initiative awaits admission to the High Court of Norway, after having partly won, partly lost in the two lower courts.

† https://einarflydal.com/wp-content/uploads/2021/02/Measurement_Report-Aidon_-Bajog-2021-02.pdf

‡ https://einarflydal.com/wp-content/uploads/2021/02/Measurement_Report_Kamstrup-Bajog-2021-02.pdf

4.11 Measurement results – Aidon

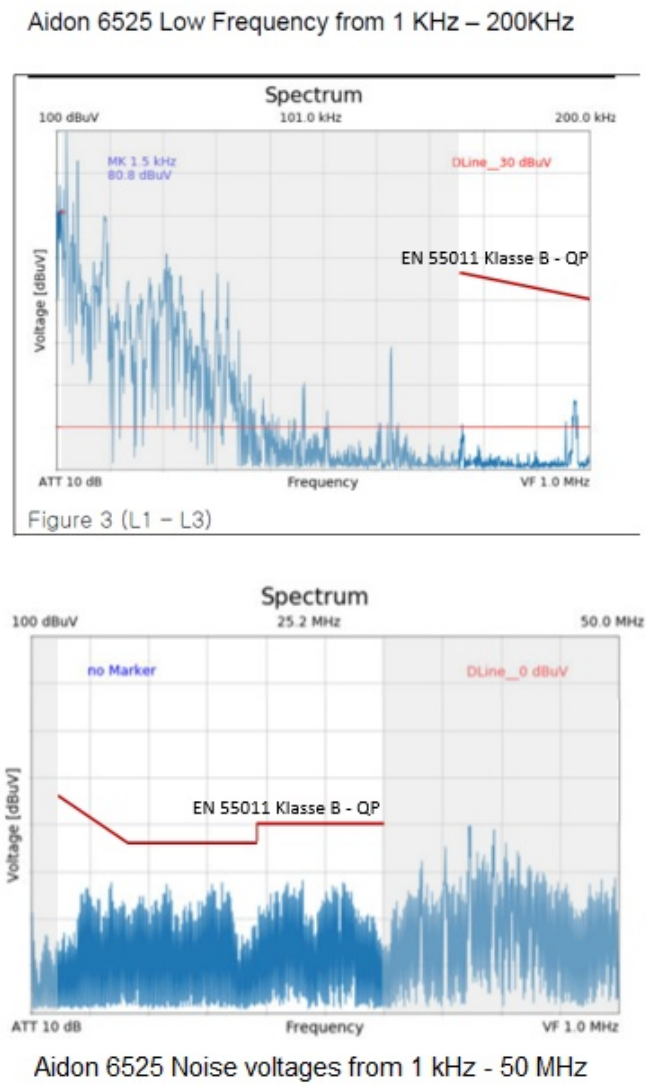

Figure 49: Measurement results – Aidon

In Fig. 49, the shaded part to the left of the upper graph shows the frequency range 2 – 150 kHz, which is unregulated. The meter readings show very strong noise voltages, 80 to 100 dBµV, in the range 1 – 60 kHz.

Being unregulated territory, this is probably why Aidon allows the release of so much noise in this range.

From 150 kHz up to 1MHz, the limit value is just 66 dBµV. The Aidon meter tested met well with that requirement.

Noise voltages in the frequency range 1 – 60 kHz will spread very efficiently on the power grid throughout the home and can be measured in the electric field.

Frequencies below 100 kHz in the electric field are very efficient as to creating electric fields in the body.

The lower graph shows that voltage noise in the frequency range 100 kHz – 50 MHz is measured to between 45 and 60 dBµV. There is much noise also in the shaded, upper unregulated frequency range (30 – 50MHz).

It was astonishing to find that much noise over such a wide frequency range. It is remarkable that in the range 30 MHz to 40 MHz, the noise reaches 60 dBµV.

With such a complex noise picture as shown in the graphs, the risk increases greatly that dirty electricity will contribute to creating currents in any body within reach, induced from the electric fields inside the home. The noise from the electricity meter will also be able to interact with noise from other sources in the home or entering the mains from outside, and will be able to have an amplified effect through constructive interference, as we have explained in previous sections.

It seems reasonable to assume that this noise alone is enough for some people to get acute health problems from Aidon AMS meters – *even after the radio module has been removed, and before any possible constructive interference.*

4.12 Measurement results – Kamstrup

The graph to the right, Fig. 50, shows the noise voltages found from a Kamstrup meter in the low frequency range 1 – 200 kHz. We see that the highest levels of noise voltages reach 67dBµV, and are found in the frequency range 1 – 30 kHz.

This frequency range (2 – 150 kHz) is unregulated. We observe that even so, the noise level is within the permissible levels in the regulated range 150 – 500 kHz. In the regulated area, the limit value is 66 dBµV.

Compared to the Aidon meter, the tested Kamstrup meter produces significantly fewer noise voltages below the regulated frequency range. On the other hand, Kamstrup produces more noise than Aidon in the 80 – 200kHz range.

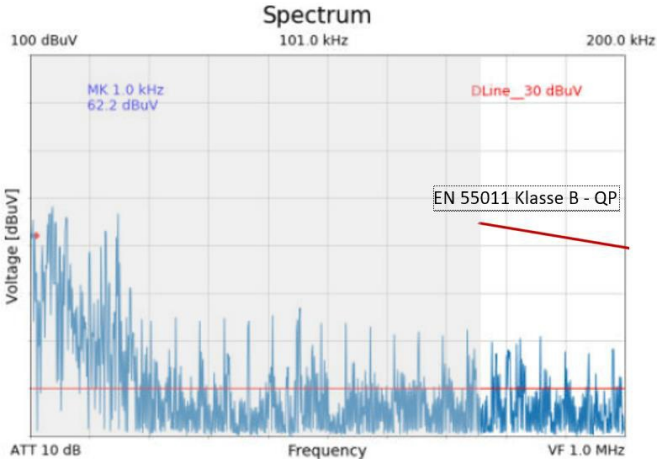

Figure 50: Measurement results – Kamstrup LF

Fig. 51 shows noise voltages in the frequency range 100 kHz – 50 MHz.

We see from Fig. 51 that the Kamstrup meter exceeds the limit value by 1 dBµV within the regulated range. Compared to Aidon, Kamstrup produces significantly more noise voltages in this regulated upper frequency range. We see that the highest levels of noise voltages are up to 61 dBµV, found at 12 – 17 MHz.

The shaded right hand side of the graph shows the unregulated frequencies up to 50MHz.

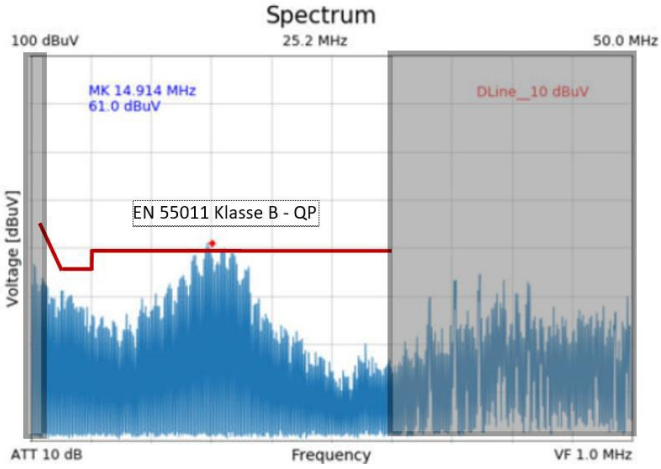

Figure 51: Measurement results – Kamstrup HF

4.13 Complex scenarios creating constructive interference not tested?

As far as we know, no network companies or manufacturers of AMS meters have tested what the noise picture looks like when tens – or hundreds – of smart meters from the same manufacturer are installed in one building, in a neighbourhood, or within the electricity network connected to their common transformer.

For example, analogous to the cases cited with LED lights, one could expect interference of various kinds, as well as the creation of various new frequencies. No systematic testing or measurements have been made, as far as we know. Neither have we seen any warnings from the meter manufacturers, the electricity network companies, nor the health authorities or the radiation protection agencies.

4.14 The measurement results and practical significance for health

We have explained above in technical terms how dirty electricity, or noise voltages, are formed and spread. And we have seen measurement results for the Aidon and Kamstrup meters that were tested. Here we revert to the question of health effects, and take a new look at the available knowledge.

Noise voltages are a general problem that should be expected to cause health problems. In several important ways, EMFs from noise voltages do not differ from the EMFs from modulated radio signals. This has been explained earlier in the book.

Furthermore, we have seen that noise voltages – referred to as “dirty electricity” or by other labels – are lifted forward both in expert opinions and by people’s practical experience as a problem particularly linked to AMS meters. They point both to the frequent pulsations from the mesh network based radio communication and to noise voltages from the power supply (SMPS) or be it other electronics in the meters.

The noise voltages measured from both Aidon and Kamstrup meters have been shown to be particularly high below the regulated area, i.e. below 150 kHz. This area is classified by the WHO as “Intermediate Frequency“ (IF) – i.e. the middle frequency range in the radio spectrum (RF). In an invited expert opinion in 2008 to the European Commission's SCENIHR committee – a scientific committee for “apparent and newly identified health risks” – the Canadian researcher Magda Havas reported her own and her colleagues' concern about interference in biological material from precisely this intermediate frequency range (IF):

> Ref. 181: Dr. Magda Havas: Health Concerns associated with Energy Efficient Lighting and their Electromagnetic Emissions, response to Request for an opinion on “Light Sensitivity” from Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), June 5, 2008,https://bit.ly/3JyJULn*

Havas refers here to what at the time were more recent studies, having shown that such frequencies “are active and can have harmful health effects“:

> Ref. 182: Havas, M. and D. Stetzer. 2004. Dirty electricity and electro-hypersensitivity: Five case studies. World Health Organization Workshop on Electricity Hypersensitivity, WHO, Prague, Czech Republic, 25-26 October, 2004. https://bit.ly/3X6Vkcp†
>
> Ref. 183: Milham S, Morgan LL. A new electromagnetic exposure metric: high frequency voltage transients associated with increased cancer incidence in teachers in a California school. Am J Ind Med. 2008 Aug;51(8):579-86. doi: 10.1002/ajim.20598.

So in particular this frequency range has been demonstrated to have significant biologically harmful effects. Also, it is made clear, the effects occur at exposure levels well below the thermal thresholds where guidelines based on the risk of heating cease to have any protective nor predictive value.

These findings, which are not at all sensational in the light of much other research, imply that both the Aidon and Kamstrup meters, and most probably also the Kaifa/Nuri meters – just to mention the ones most in use in Norway – most certainly should be linked to an increased risk for health problems to occur everywhere such meters are installed. At the aggregate level, these findings imply that the typical symptoms of *the microwave syndrome* will become visible in a larger share of the population than before installation.

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* https://www.magdahavas.org/wordpress/wp-content/uploads/2009/10/08_Havas_CFL_SCENIHR.pdf

† https://www.researchgate.net/publication/228978746_Dirty_electricity_and_electrical_hypersensitivity_Five_case_studies

In her report, Havas refers to several cases in schools in the USA, where abnormally high incidences of cancer among the teaching staff could be linked to high levels of dirty electricity in the classrooms in which they taught. She also refers to four similar studies of electricity quality and health in schools in Toronto and in Minnesota: The studies found that improvements in power quality, i.e. filtering the electricity to get rid of noise, triggered better health among teachers and behavioural improvements among students.

Furthermore, Havas writes (Ref. 181):

> "We have conducted studies with diabetics and people who have multiple sclerosis and found that when the dirty electricity in their home is reduced their symptoms diminish. Both type 1 and type 2 diabetics have lower blood sugar and type 1 diabetics require less insulin when they are in an electromagnetically clean environment. People with MS have fewer tremors, improved balance, less fatigue, and several have been able to walk unassisted after the dirty electricity in their home was reduced (5)."

Accordingly, Havas points out that the health problems associated with the frequencies in the intermediate range between ELF (Extra Low Frequencies) and RF (Radio Frequencies) need regulation, and that stricter regulation has been requested from the medical profession in a number of appeals and declarations. She concludes as follows:

> "With a growing number of people developing electro-hypersensitivity we have a serious emerging and newly identified health risk that is likely to get worse until regulations restricting our exposure to electromagnetic pollutants are enforced."

So, again, it follows from the paragraphs above that there is good reason to expect the Aidon and Kamstrup and Kaifa/Nuri meters as well as others with similar technology and frequency use, do trigger acute health problems. Such an assumption agrees with what is reported: Some people get acute health problems after installation of the meters, and they report the same symptoms others are reporting as well. This can be read from various counts (see section 2.1) and from self-reports, as in the approx. 150 collected here (in Norwegian) by one of the authors of this book:

> Ref. 184: Smart meter self-reports, https://bit.ly/3jhPSp0*

Instead of being informed about the risks, consumers receive assurances from public authorities and electricity companies online and in the mass media that no such risks exist. Nor can they opt out:

Unlike energy-saving bulbs, LEDs, and other equipment that creates noise on the power grid, the AMS meters cannot be turned off without losing the electricity in the entire home. Even so when opting out from the radio communication: The dirty electricity is still there.

Health problems over time

What about health problems not acute, but emerging *over time*? May they also be caused by such meters?

An established model for understanding disorders triggered by environmental stressors over time is presented in the book preceding this one: Part 2, Chapter 2, point 17 (Cocktail effect and threshold value) (p. 35), and Part 2 p. 206 in

> Ref. 185: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, Part 2, https://bit.ly/3BI97h3†

* Full link: https://einarflydal.com/smartmaler-historier/

† Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

We had found the model in:

> Ref. 186: Hecht, Karl: Health Implications of Long-term Exposure to Electrosmog – Effects of Wireless Communication Technologies, Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V., 2016, https://bit.ly/3RmPBxx*

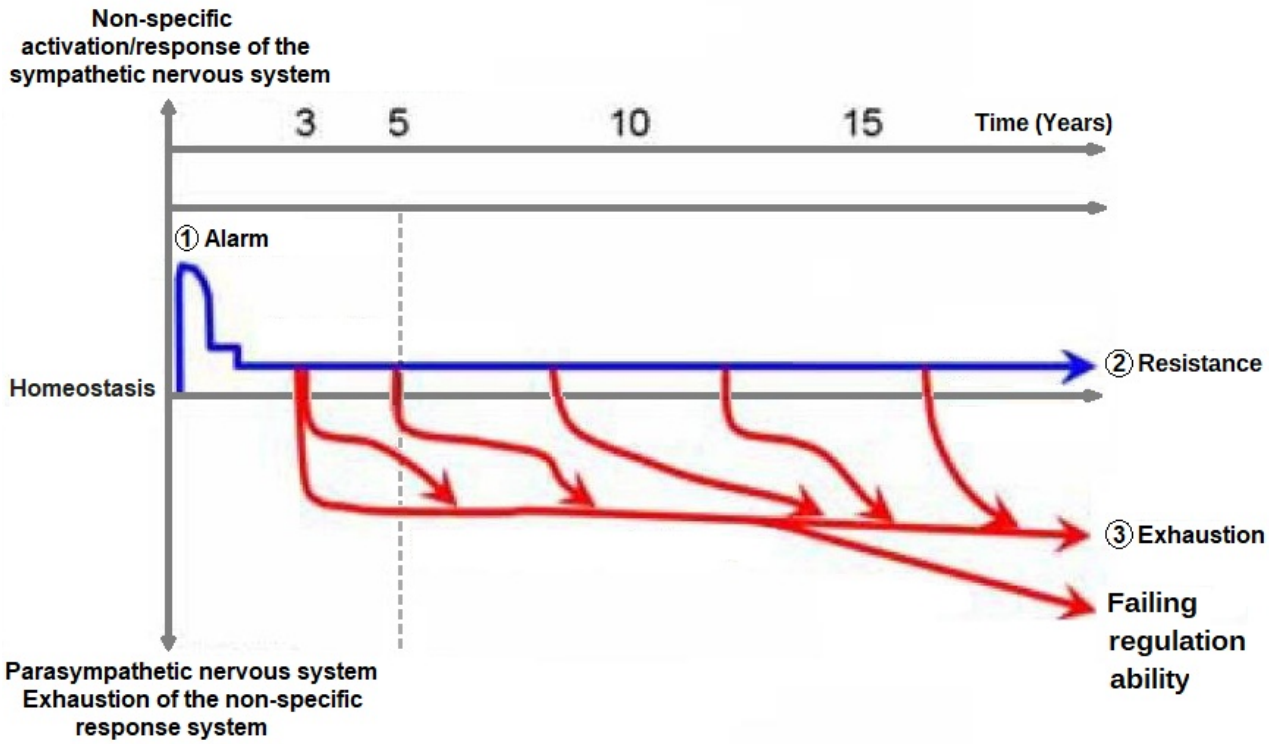

Figure 52: The course of development from acute reactions to health failure over time (Hecht 2016)

The model shows that the development of morbidity proceeds quite schematically:

1. First, the sympathetic nervous system reacts – mildly with the vast majority of people, strongly with some (the 'hypersensitive' ones).
2. Then the affected of the body's many systems compensate to maintain their balance (homeostasis), but
3. Eventually, the biological stress situation becomes too strenuous, and then one or more of the body's regulatory systems fail. Health problems and illness development then show up – perhaps after only three years or after 10, 15 or 30. For some they never appear.

This model succeeds in bringing together research findings from the very extensive Soviet long-term studies of biological effects to EMF exposure, and knowledge in general environmental medicine. Hecht (deceased in 2022) was a veteran of the German Democratic Republic and Soviet Union research within the field. Together with Balzer he used this model in 1997 in a report written on request from the German Radiation Protection Agency. The assignment was to provide an overview of Soviet research results in the field of biological effects from EMFs, which they did: They reported significant biological effects on every imaginable part of the human body.

* Full link: https://kompetenzinitiative.com/english-brochures/

Hecht's and Balzer's report was simply put on a shelf and not made available. In 1999 it was translated to English and let loose:

> Ref. 187: Hecht, K. & H.-U. Balzer (1997): Biological effects of electromagnetic fields in the frequency range 0 to 3 GHz on humans. Commissioned by the Federal Institute for Telecommunications. Contract No. 4231/630402. Review of Russian research literature between 1960 and 1996, https://bit.ly/3RiZQ69*

Hence, both long term and acute biological reactions have been studied and mapped over many years. Also in the form of blind tests. Early in the 1990s formation of mast cells – a known acute bodily defence reaction in the skin – was found in blind tests on the subjects' backs when exposed blinded to cathode ray tube screens (old-fashioned TV/computer screens).

> Ref. 188: Johansson O, Liu P-Y. ''Electrosensitivity'', ''electrosupersensitivity'' and ''screen dermatitis'': preliminary observations from on-going studies in the human skin. In: Simunic D, ed. Proceedings of the COST 244: Biomedical Effects of Electromagnetic Fields – Workshop on Electromagnetic Hypersensitivity. Brussels/Graz: EU (DG XIII), 1995; 52.

Similarly, exposure studies have found the development of *heat shock protein* (HSP), without heating.

> Ref. 189: D. Leszczynski, S. Joenväärä, J. Reivinen, R. Kuokka, Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood–brain barrier-related effects, Differentiation 70 (2002) 120–129

A number of studies show acute exposure effects on the cells' oxidant production, with a number of different downstream effects which are described elsewhere in this book (see Section 2.10).

Such acute reactions produce *objective* findings that cannot be explained away by referring to psychology.

As to AMS meters, those who are in contact with people who got health problems with AMS meters, come across many cases where people tell they got health problems shortly after AMS meters were installed, e.g. a strong tinnitus or pains – even when installed by their neighbours, and without being themselves sceptical of such meters in advance. Often they did not even know installation has taken place, nor that health problems from AMS meters were an issue.

We know of several cases where people have given up their home and stay more or less temporarily in a cabin, in a tent or at a parking lot to reduce and avoid symptoms. Since such cases only happen on an individual basis and no registration takes place in the healthcare system, they remain invisible and only appear now and then in the newspapers' feature stories about some odd electro-sensitive person living an exotic life "off the grid", commented by a psychiatrist or someone from the Radiation Protection Agency assuring there cannot be any health effects from such weak radiation.

Hence, since long established science as well as practical experience tell that the noise voltages from the Aidon and Kamstrup AMS meters should be taken as strong indications that AMS meters cause biological harm.

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Is the general increase in EMF-pollution of the environment reflected in epidemiology?

* Full link: https://einarflydal.com/wp-content/uploads/2023/01/EMF1997_BALZER_HECHT_ENG.pdf

In Hecht's and Balzer's model above (Fig. 52), the long-term development follows a well-established, general pattern for the development of disease from biological stress: Morbidity only breaks out when certain thresholds, which cannot be predicted but at best be guessed, are exceeded. When transgressed, people become permanently, or long-term, ill.

The model thus predicts that the persistent burden from AMS meters in the home, often in interaction with other environmental stressors, will be expressed as a general increase in morbidity, thinly distributed over many diagnoses and with individual causal relationships that will not be directly verifiable.

Richard Lear has pointed out that such a trend, where EMF's and other environmental stressors interact, seems clearly visible in the US population. He suggests that those diagnoses having increased the most, are caused by oxidative stress and that man-made EMF's is the environmental stressor behind, having become ubiquitous and so much stronger during the last three decades.

> Ref. 190: Lear, Richard: A Biological Model for the Diseases of Civilization, October 2018, presentation, https://bit.ly/3HIT8TR*

ADD/ADHD 139%	Allergies 104%	Alzheimer's 299%	Anxiety 104%	Asthma 142%	Autism 2,094%
Autoimmune Disease 221%	Bipolar Disorder (youth) 10,833%	Cataracts 480%	Celiac Disease 1,111%	ME/Chronic Fatigue 11,027%	Congenital Heart Disease 143%
Chronic Obstructive Pulmonary Disease 148%	Depression 280%	Diabetes 305%	Erectile Dysfunction 150%	Fibromyalgia 7,727%	Inflammatory Bowel (IBD) 120%
Hypertension 223%	Kidney Stones 246%	Kidney Disease 413%	Leukeamia 588%	Lupus (SLE) 787%	Melanoma 145%
Multiple Sclerosis 117%	Obesity 260%	Osteoarthritis 449%	Panic Disorder 263%	Psycho-Social: Attentional 819%	Psycho-Social: Emotional 2,500%
Sleep Apnea 430%	Sleep: Insomnia 123%	Squamous Cell Cancer 177%	Stroke 262%	Thyroid Dysfunction 233%	Hypothyroidism 702%

Figure 53: The growth in chronic health disorders in the USA 1990 – 2015. All linked to oxidative stress/elevated oxidant production (from Lear 2018).

Lear's message is elaborated in:

> Ref. 191: Lear, Richard: A New Era of Chronic Disease in America and what's behind it, August 2017, https://bit.ly/3JuCHvN†

It is precisely such thoughts that lie behind the very concept of *electrosmog*: The diagnoses will be spread thinly, the statistical connections will therefore be weak and difficult to find, and the causes will be difficult to verify in any specific case at the individual level. In practice, it will hardly be possible to determine whether, in the individual case, a person has become ill because he is

* https://www.researchgate.net/publication/326901722_A_Biological_Model_for_the_Diseases_of_Civilization

† https://www.researchgate.net/publication/319288113_A_New_Era_of_Chronic_Disease_in_America_and_what's_behind_it

generally particularly sensitive, is sensitive to specific frequencies or pulse patterns, or became ill due to some specific patterns created by local interference – at some specific "hotspot", or from some completely different reason. It is the *syndrome* – the ensemble of certain specific symptoms in the wider group – that provides the evidence.

We have seen that the symptoms and that the AMS meters have the property that makes them *a likely significant contributory cause:* their production of both low-frequency, medium-frequency and microwave frequencies, strongly pulsed fields, both from their transmitters and from their electronics.

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The general model Hecht and Balzer use to explain acute and long-term reactions to EMF exposure (Fig. 52), does not deal with interactions between several environmental stressors, but basically with how the organism responds to *persistent* or *enduring stress*.

The underlying understanding of how the organism responds to persistent stress was developed by the Hungarian physician Hans Selye in the 1930s, and is known and established as *the general adaptation syndrome* (GAS). The model is general and open to all types of biological – and psychological – stress. When Hecht and Balzer used it, it was simply because the results from the Soviet long-term studies lent themselves to be understood through Selye's GAS model: They found that also for long-term EMF exposure – at exposures well below heat-based exposure limits – the GAS model provided a fruitful description of the process leading to sickness development.

(For more on the general adaptation syndrome, see

> Ref. 192: "Stress", in Wikipedia (general adaptation syndrome)
>
> Ref. 193: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3* Part 2, Chapter 2 point *17 Cocktail effect and threshold value*, and Chapter 13.
>
> Ref. 194: Flydal, E: "What is electro-hypersensitivity? The piece I missed, I found in Pest", blog post, 24/10/2015, https://bit.ly/3Jvf465†)

Causation when dealing with several environmental factors in interaction, is challenging. Sorting out the various stressors in situations with many electromagnetic fields with many different properties the more so, as the complexity of such situations is overwhelming. This means that it is not possible to make meaningful risk estimates for real situations from simple lab tests: The discrepancy between the complexity of real life, and the simple situations in which radiating devices are tested, means that lab tests are just gross simplifications. They should be regarded with strong scepticism when used to discard findings from real life. No one can claim on the basis of a lab test that "this device has no detrimental effect".

There are reasons to assume that voltage noise from the AMS meters may interact with other environmental stressors to cause acute or long term effects. The research we have presented and the experiences we have gained also make it quite conceivable that the total voltage noise from the total number of smart meters in a neighbourhood can give individuals the crucial extra burden that causes them to suffer from MUS – "medically unexplained symptoms" after installing new meters, even without a transmitter.

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* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

† (Norwegian) title: "Hva el-overfølsomhet egentlig er? Brikken jeg savnet, fant jeg i Pest", full link: https://einarflydal.com/2015/10/24/hva-el-overfolsomhet-egentlig-er-brikken-jeg-savnet-fant-jeg-i-pest/,

5. How to reduce electromagnetic fields and noise from the smart meters

Here we look at how to reduce radiation and electrical noise (“dirty electricity“) from smart meters, with radio communication as well as without, and noise that enters the home from outside, i.e. from the external power grid.

First we look at ways to reduce radiation from the AMS meters' transmitting antennas, then at dirty electricity.

The manufacturers of at least some of the AMS meter brands installed by Norwegian electricity network providers, supply wired communication, i.e. cabling, between the meters in the local network, and between the local network and the central “head-end” system.

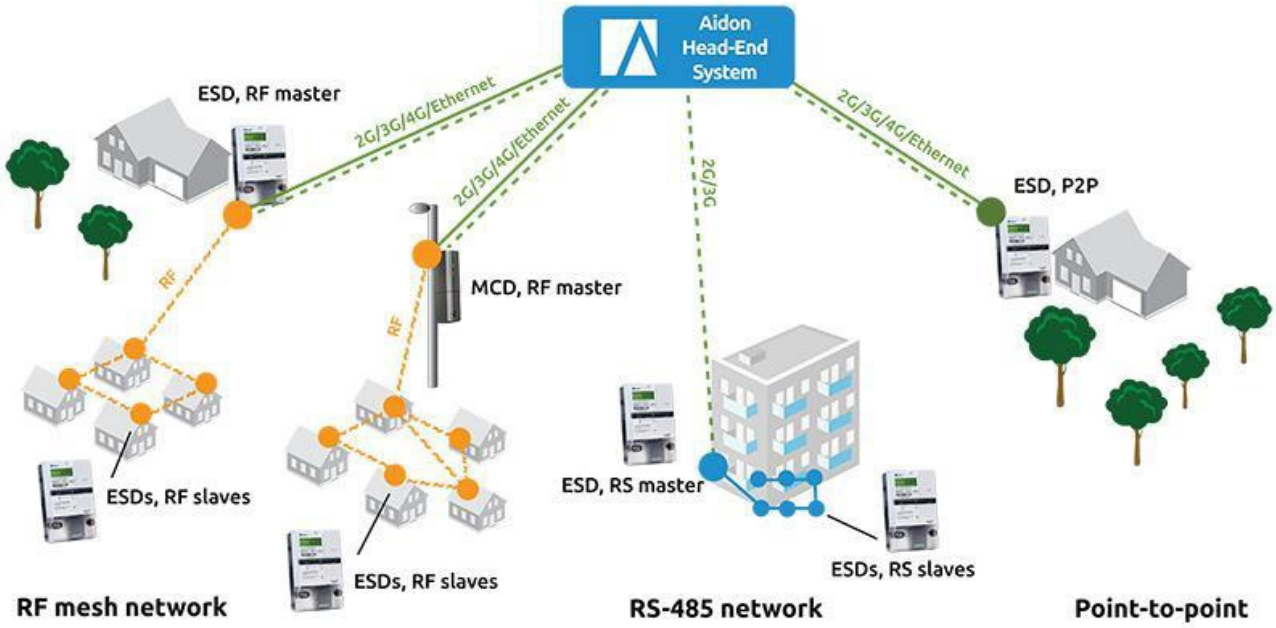

Figure 54: Aidon's standard solutions
(source: Aidon's Finnish website, 2018)

These wired solutions are standard equipment. The AMS meters could therefore easily be wired in apartment blocks' meter rooms where all meters in the block may be located, instead of them all communicating wirelessly and constantly to each other at a few centimetre’s distance. Also, if the meters are installed at each floor in the stairwell, or even in separate buildings, they could be wired using standard solutions and standard networks (e.g. RS-485) of up to 1200 metres cable length.

However, wired solutions were disregarded by the Norwegian network companies. They decided on wireless solutions only. Figure 54 above shows various options from the Aidon manufacturer: blue lines: cabled network, yellow lines: mesh (wireless) networks, green lines: Ethernet (various wired solutions).

5.1 The radiation from AMS meters

The three main brands of AMS meters installed in Norway are Aidon, Kamstrup and Kaifa/Nuri. They are all set up to use radio transmissions to transmit electricity consumption data to the

electricity companies, as well as to report on technical matters, like power outages etc. Software updates are also done wirelessly as they have no wired connections for such communication. Just a handful of small electricity network companies in Norway use signalling on the power grid: *PLC* (*Power Line Communication*, see below).

Most meters are linked together locally in (wireless) *mesh networks*.

(In Norway, quite a few meters have been configured to use GPRS – which is data communication via the mobile network standard UMTS (3G/CDMA), particularly in isolated areas and in some cases as the result of health complaints from customers, as UMTS means fewer and less sharp pulsing. We concentrate on the mesh networks in this text.)

(Configuration as a “master” or “end node” in the mesh network (see Fig. 54), is a way of changing the communication properties of an AMS meter, to the better for some and to the worse for others.)

Through the mesh network, all the meters within an area communicate with each other and thus ensure that there are at all times multiple paths for communication between the smart meters within the mesh network and the network company. The meters keep in touch by sending short pulses. Depending on the type of AMS meter and communication setup, these pulses are sent from 1-2 times a second (Aidon) to approx. every 15 minutes (UMTS). The pulses are very short, from around 12 milliseconds up to a few seconds. When the meters within a (local) mesh network transmit their user consumption data (e.g. every hour), or get their software upgraded (at several days’ or weeks’ intervals), transmissions may take much longer. For the network companies’ convenience, software upgrades mostly happen during the night.

We have frequently been contacted by people reporting they wake up with heart or other abnormal health issues just when such reports and software upgrades take place.

As the intention is that AMS meters shall become gateways, or platforms, for various automated services offered to the network clients, one should expect the communication volume to rise in the years to come.

As to the energy intensity from the transmissions, the AMS meters start at full power, automatically adjusting down the transmission power according to local conditions. If distances between the meters are far, the radiated power is high. Since the setup of the mesh networks takes place automatically and is dynamic, i.e. the network is reconfigured whenever conditions change, there may be large local differences as to the signalling powers from each individual meter. Also, the transmission power can change suddenly, e.g. if there are temporary obstacles between the meters, e.g. a van with metal sides, then the mesh network starts reconfiguring.

As to transmission volume, meters of the Aidon brand stand out in a negative direction, as these meters transmit much more often than the other two brands: While Kamstrup and Kaifa/Nuri meters transmit 164 and 4,320 short electromagnetic pulses per day, respectively, Aidon meters have been measured to around 83,000 pulses per day. (Software updates might change the pulse frequencies.)

More details as to the power intensity of these AMS meters in relation to various radiation standards and recommended exposure limits are found in

> Ref. 195: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3*, Part 2, Sections 3.2 and 5.2.

* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

Such data is therefore not referred in detail here. Here we only cite from an analysis of a real life situation (Ref. 195, Section 3.2) in order to put the AMS meters' radiation into perspective:

> "We see that calculated exposure at the nearest bed pillow is 76 to 150 times weaker than the Norwegian Radiation Protection Authority's ICNIRP-based limits, but 222,000 to 4.4 million times stronger than EUROPAEM's biology and experience based recommendations for the normal [i.e. not particularly sensitive] population."

These sources, ICNIRP's thermally based guidelines and the guidelines from the European Academy for Environmental Medicine, EUROPAEM, are dealt with elsewhere in the book, Ref. 20 and Ref. 229, respectively.

5.2 Much can be done to reduce radiation at home

It is not complicated to reduce the radiation within the home from AMS meters, but you have to know what you are doing. Otherwise the result might turn out both expensive and bad – even worse than before.

5.2.1 External outdoor antennas: Moving the radiation outdoors

AMS meters have a built-in antenna (and normally several others, in order to take on a role as the home's communication hub, but we shall leave that for now). Normally, you may connect an external antenna with a long co-axial cable, which means moving the radiation out of your house – at least if you use a directional antenna and/or shield it in the direction of your home. This may significantly reduce exposure intensity – depending on distance and shielding between the antenna and indoors.

But remember that what you do, is just moving the radiation out into the external environment. There is extensive analysis documenting that our living environment – insects, birds, plants, trees, etc. – is also significantly damaged by man-made radio communication and ever-increasing electricity use. (Documentation about this can be found elsewhere in this book.)

Moving the radiation outdoors is therefore no solution to these challenges which are now slowly advancing on the world's environmental agenda. In addition, such a solution will normally increase some of your neighbours' exposures, as you move the antenna closer to their homes with less shielding. Still, under some circumstances it might be the best solution at hand and therefore mentioned here.

An external antenna may be used whether the AMS meter is set up for mesh networking between the meters in the area, or uses GPRS or any other mobile network. Normally, all meter models are equipped for an external antenna and if connected, the internal antenna will be automatically switched off. (You better check with an exposure meter!)

Our experience is that most electricity network companies will accept to install an outdoor antenna – at the cost of the electricity client. Companies might also accept installing outdoors antennas for other meters in the same apartment building, "out of consideration for neighbours", though still at the cost of their customers. We are familiar with cases where electro-hypersensitive persons have experienced that this solution may save them from getting ill from neighbours' AMS meters – or at least reduce the exposure considerably. However, we have also witnessed cases where such solutions are not enough.

If you consider an external, outdoor antenna, you should be aware of the following:

How long should the antenna cable be?

The location of the antenna is very important and determines the cable length. The cable length must be limited, since the longer the cable, the greater the signal loss. At each joint, or connection point/coupling, there will be some radio waves leaking. (You might shield the coupling with metal tape.) If the meter is already far away from the other meters with which it is supposed to communicate, the signal loss in a long antenna cable may be just what it takes *not* to be able to communicate in the mesh network.

Standard extension cables of 3, 5 or 10 metres are at hand from electronics shops. In addition, there is normally a fixed 1.5 meter cable on the antenna. The companies have different practices as to which lengths they accept. Some companies accept up to 21.5 metres, while others only accept 11.5 metres. Network companies might exceptionally accept a slightly longer antenna cable.

The location and direction of the antenna is important

Often, an external antenna is mounted just outside the metal fuse box, indoors, to have a better signal. A so-called *toblerone* or *triangle antenna* is the one most common used. It radiates in a wide angle, approx. 180 degrees, and will normally send very little radiation backwards. The antenna is about the size of a pair of glasses, some 15 x 5 x 5 cm. It may be covered with paint (not metal or shielding paint).

Such antennas might also be used outdoors, e.g. on the house's outer wall. To create an efficient shielding backwards, a lead plate may be fixed on the wall behind the antenna, creating "radio shadow" behind it. Also, antennas with more narrow angles exist.

Omnidirectional antennas for outdoor use are also common. These should not be used near areas where people stay: They radiate with equal intensity in all directions, i.e. also towards the interior of your home.

You should position the antenna so that you make use of the full cable length, and ensure that the antenna points away from the home. The antenna should preferably be mounted on the external wall or otherwise as far away as possible from bedrooms and living areas where you spend several hours a day. Also, you should avoid pointing the antenna towards your neighbours. The best option being no antenna at all, the second best is to find a position for the antenna so that it aims towards the nearest network station. Then the signal from the antenna will be weakest.

Directional antennas normally have a higher effect (signal strength/power) than omnidirectional antennas. Thus, the radiation from an external antenna may be more intense. The meter will usually compensate for this automatically by dampening the signal when it detects the power needed for stable communication. However, this takes some time.

The meter will always turn the power (and thus the radiation) up to full strength during the set-up period, until it has adapted to the other meters in the area. After installation, the meter may take one to two days to adjust.

When the fitter comes to activate the antenna, you should make sure that the meter is set up correctly. The meter should only communicate through the external antenna. In the worst of cases, both antennas will be active. Simple measuring will certify this is not happening.

One external antenna for several meters?

Connecting meters with a cable is, as mentioned (and shown in blue in Fig. 54 above), a standard solution from manufacturers. They also supply cables in short lengths for connecting meters mounted in racks. However, Norwegian grid companies cancelled this option, probably to save

installation time and costs, as mesh networks autoconfigure. Therefore, in the Norwegian context, even in an apartment building where meters are located next to each other, mesh networks are used, and cannot be replaced by cabling. Each meter must use its own antenna, with one of the meters taking care of the communication with the network provider.

Hence, either;

1. all meters must transmit wirelessly to each other in a mesh radio network, even while being just 10 cm apart in the basement. Then one of these meters might have an antenna mounted on the outside of the house to communication with the network provider.
2. or worse; all the meters must have their own external antenna mounted outdoors.

The electrical network companies have different application processes when applying for external and/outdoor antennas to be installed.

How much does an external antenna cost, and who does the work?

The companies have different practices. Some do the whole job free of charge. This means that they do not charge for the antenna itself, neither for the cable, nor for the installer, but that the customer must provide a routing path from the fuse box to where the antenna is to be located, e.g. on the outer wall of the house. This must then be prepared, with holes drilled, before the fitter arrives. You may do the work yourself, as long as it conforms to their specifications, or you may get an electrician to do the job.

5.2.2 Communicating meter data via the mobile/cellular network

In sparsely populated areas, or where the environment is challenging, electricity network providers may prefer using the mobile/cellular network for some or all of its smart meters. GPRS (General Packet Radio Service) is one such (European) standard for mobile data communications used over the 2G (GSM) and 3G (UMTS), 4G and 5G mobile / cellular communication network. Other standards exist.

When there are no active transmissions of content, the signalling is much less frequent in the mobile network's system. Also, the pulses are less abrupt and powerful than in mesh networks. The older the network system, the fewer the number of pulses. This has so far made mobile network solutions less prone to provoke acute health problems. Some EHS sufferers therefore find GPRS and similar solutions acceptable.

Replacing a mesh networked AMS meter with a mobile networked one involves replacing the communication module in the meter with a module for mobile data communication. (See Fig. 53, right hand side for an example.)

Such a technical solution might have an internal or external antenna. The meter will send short "beacon signals" every, say, eight minutes or so (as if it were a mobile device), and transmit meter data via 2G, 3G or 4G (or 5G) mobile data networks as often as the system is configured to report – maybe once an hour or once a day.

Note: If you live in an area with poor mobile coverage, the radiation from the mobile data communications may be relatively strong whenever the meter connects to the mobile network to send data.

5.2.3 To force an AMS meter to into being an "end node"

AMS meters normally have a built-in technical solution that may help reduce radiation load:

The meters are normally set to re-transmit the signals from other meters via the mesh network. One of the meters automatically takes on a more central role as a concentration point (and bottleneck), being responsible for communication with the network company's data system. Hence, all the meters have more emissions than if they were alone and such a connection point has a particularly high activity level. Accordingly, they emit more radiation.

A meter will transmit less data if it is configured as an "end node", i.e. a network node with no other connections but the network company's data system. In such a setup, the end node communicates directly with the concentration point and is not part in any mesh network. Network companies may configure any meter to act as an end node.

If the AMS meter is set as end node, the smart meter only sends its own measurement data to the electricity network company (via some concentration point) and the meter is not available to receive and forward data from other meters.

Note: It is the electricity network company which must arrange for this to be done. The company may only accept the end node solution if it does not cause problems for the rest of the mesh network.

5.2.4 Power Line Communication (PLC)

Power Line Communication (PLC) is a technology that communicates (and sends messages about power consumption) via the power grid itself. We have been told that in Norway, about 10-15 percent of the AMS meters installed communicate this way, i.e. using PLC. One of the few network companies using PLC is Meløy Nett.

AMS meters using PLC seem to use frequencies in the range 2 kHz to 150 kHz on the wiring network.

PLC communication may be a solution when meters transmit rarely, e.g. only once a day. If they send more often, this is not a solution we would recommend: The pulses transmitted on the wiring network will be distributed over the entire electrical wiring in the home, in the same way as all other dirty electricity.

In France, the introduction of AMS meters (called "Linky", no matter which manufacturer) is based on PLC as the standard solution, supplemented with wireless solutions. As you will see elsewhere in this book, this has led to a number of court cases where the grid company has been ordered to turn off the meter's communication because of dirty electricity having made EHS people sick.

However, we know of a case in Norway where a very electro-sensitive person who could not have a wireless solution without experiencing severe acute health problems, was offered PLC, which was then tried out with significant help from the network company. In that particular case, the PLC solution caused no acute problems.

Ref. 196: emails between subscriber N.N., Meløy nett and Einar Flydal, 2020

Once biological reactions to EMFs are accepted, such cases confirm how varied and individual the biological reactions may be. This great variation in reactions has been misinterpreted – to believe the reactions must have other causes, or be psychologically conditioned. This is still the public view of Norway's health authorities.

5.3 Application for exemption for AMS

The Energy Regulatory Authority (RME) and the Norwegian Water and Energy Directorate (NVE) have opened ways for the grid company to grant exemptions from the obligatory AMS-system if being part of it is of “significant documented disadvantage”.

> Ref. 197: Letter from NVE to FELO, organisation for EHS people, ref. NVE 200701944-252 ek/ave, 14.03.2012, on exemptions for electro-sensitive persons, https://bit.ly/3Kps39P*

In practice, an exemption has so far meant an exemption from the AMS meter's radio transmitter if you have a doctor's certificate stating that you have *acute health problems* from electromagnetic fields:

The argument that 24/7 active microwave transmitters with sharp pulsing generally create an increased health risk, has not been accepted as a reason for exemption. A number of people who have had applications for exemption from AMS refused by the network company on the basis of general health risks or out of their wish to protect electricity-sensitive neighbours, have complained to NVE and, after refusal, appealed to the Ministry of Oil and Energy (OED).

As far as we know, all such complaints have been rejected by NVE, RME and OED, referring in their decisions to the ICNIRP thermally based exposure limits, to the “weak” radiation from the transmitters and to the radiation protection agency DSA's claims that there is no biological impact proven, as well as to the important role of AMS meters in the introduction of a new market based power distribution system and its highly beneficial role for society.

For an example of rejection, see

> Ref. 198: Refusal from OED to N.N. on appeal against NVE's decision, ref. 16/367, 2.10.2017, https://bit.ly/3XPLgVn†

The Norwegian Directorate of Health has prohibited health personnel from stating that the patient cannot tolerate the radiation from the AMS meters' transmitters. However, several legal investigations have concluded that the Norwegian Directorate of Health does not have the right to issue such a ban, see for example;

> Ref. 199: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3‡, Part 1

The Directorate of Health specifically states that medical doctors are not permitted to state that the patient suffers health problems from radiation from AMS meters, as, allegedly, such causation is not possible. Many disagreeing doctors have written such certificates anyway. Also, the Norwegian Water and Energy Directorate (NVE) has instructed the electricity network providers to have a low threshold for accepting opt-outs. In practice, the electricity network companies do accept doctors’ statements which, without any medical evaluation, simply cite the patient's statement.

Therefore, to have the opt-out request accepted, it has so far been enough for the doctor to state that the patient claims to be experiencing health issues from EMFs. In this way, the doctor does not present any opinion of his own on the matter, and Norwegian health authorities' illusion that the

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* (Norwegian), full link: https://einarflydal.com/wp-content/uploads/2016/10/dispforel-overfc3b8lsommenorge.pdf

† (Norwegian), full link: https://einarflydal.com/wp-content/uploads/2021/03/201700796-9-Svar-pa-klage-pa-NVEs-vedtak-om-installasjon-av-AMS-maler-21....pdf

‡ Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

symptoms have other causes, possibly purely psychological, is not challenged strongly enough to become a political or administrative problem.

However, a number of cases have been brought to court in which electricity clients without doctors' certificates claim their right to resist a new AMS-meter being installed. They have so far (spring 2023) all been lost regarding the relevance of health issues.

As network companies have threatened to, or indeed cut off the electricity in cases where they have not got access, there have been many claims for temporary injunctions. Almost all of these cases have been decided on grounds other than health.

For an (incomplete) overview of AMS cases that have been before Norwegian courts, see a list of 20 court cases in

> Ref. 200: Flydal, E: Overview of court cases on radiation and health, blog post 12.12.2022, https://bit.ly/3Kwh8LI*

Exemption from switching to a new meter due to health problems from *dirty electricity* has so far not been accepted. However, to our knowledge, several people have received temporary postponements from certain more flexible network companies.

As far as we know, as of date (15/3/2021), no cases have been heard in the Norwegian judiciary where health as a reason for exemption for the installation of equipment that produces dirty electricity. Nor have any other justifications been accepted, such as privacy, social security, or anything else.

Below, in 5.4.2, you will find a new procedure that covers microwaves as well as dirty electricity, and is based on the instructions given by the court in the most recent Norwegian verdict on the matter until now (February 2023).

5.4.1 How to apply for an exemption from the microwave transmitter

To apply for an exemption from AMS, you must submit a doctor's or psychologist's opinion to the electricity network company. You must find a doctor or psychologist who will print out a certificate. It is accepted for exemption that the doctor or psychologist writes that:

- you fear that the radiation may cause health problems, or that
- you believe yourself that you cannot tolerate such radiation.

The application is sent to your electricity network company. The energy authorities (RME, NVE) have decided that all electricity network companies are obliged to accept applications with such a statement from a doctor or psychologist. No electricity network company has the right to refuse such an application.

What you are then actually exempted from, is the microwave transmitter in the AMS meter, only. When this is switched off / removed, the meter is by definition no longer an AMS meter, just a new electronic/digital meter.

What you have *not* been exempted from is the *dirty electricity*. An exemption from dirty electricity is a harder nut to crack. If you consider dirty electricity to be a problem, you should first and foremost take a look at what other measures you are able to take in your home to protect yourself

* (Norwegian) "Oversikt over rettssaker om stråling og helse", full link: https://einarflydal.com/2022/12/12/oversikt-over-rettssaker-om-straling-og-helse/

from other sources such as; dimmer switches, mobile phone chargers, car chargers, energy saving bulbs, power supplies, etc., and from interference between them.

Dirty electricity from an AMS meter may be the “drop that makes the glass overflow”, but so might other sources as well.

5.4.2 An application procedure for exemptions both from the microwaves as well as from the AMS meter’s dirty electricity

As part of a verdict of 3 November 2022 in a Norwegian court of appeal, a “recipe” is given by the court as to how to apply and obtain an opt out from the microwaves and/or the dirty electricity from an AMS meter.

> Ref. 200b: Verdict no. 21-136295ASD-BORG/02, 03.11.2022, (Norwegian), https://bit.ly/3Z9A1rU*

An essential point in the verdict is that the medical doctor’s certificate should only state that the symptoms declared by the patient are possible symptoms of “what is in common language described as EHS symptoms”. Hence, the verdict circumvents the conflict between the demand for a doctor’s certificate and the prohibition to issue such certificates, as well as the fact that EHS is not a medically accepted diagnosis in Norway.

Also, the patient’s symptoms – whether subjective or objective – should somehow be verified to be connected to exposures from man-made EMF’s.

In addition, the verdict states that it is the responsibility of the electricity network provider to cater for absence of dirty electricity from the meter if a connection to health issues for the patient is made reasonable.

With the help of lawyers and medical doctors we formed a procedure for opt-out applications both as to microwaves and dirty electricity, strictly following the recipe given in the mentioned verdict of 3 November 2023. (The verdict has been appealed to the High court, and a decision whether the case will be admitted is awaited by March 2023.)

> Ref. 200c: Procedure and forms for opt-out applications both as to microwaves and dirty electricity, (Norwegian), https://bit.ly/3XVimmN†

5.5 Shielding against the AMS meter

Some are in a situation that makes it impossible to get an exemption from the AMS transmitter, for example because they just rent a flat temporarily, or because they are affected by their neighbour's AMS meter, having an exemption only for their own. It is still possible to reduce the radiation with the help of various *shielding measures*:

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* (Norwegian), full link: https://einarflydal.com/wp-content/uploads/2022/11/Dom_av_av_3._november_2022-SLADDET-kun-saksokere.pdf

† Norwegian title: *Framgangsmåte for fritak fra AMS-måler*, Utarbeidet av Foreningen for EMF-reform i samarbeid med advokat Hugo P. Matre, Advokat Schjødt AS, med innspill fra flere norske leger og fra FELO, foreningen for el-overfølsomme, oppdatert per 12.12.2022, https://einarflydal.com/wp-content/uploads/2022/12/Framgangsmate-for-fritak-fra-AMS-maler-v.1.0-20221212.pdf

Several electrically hypersensitive people have been helped by using shielding carbon paint on walls, floors and ceilings, shielding wallpapers, curtains, tents or clothes made of fabric with fine interwoven metal threads.

Such materials are highly effective and can significantly reduce exposure. The efficiency is stated on the products and can be verified with simple measuring devices.

It is very important to follow instructions carefully as to how the shielding should be carried out. More radiation can occur inside the shielded area if you don't do things right:

Imagine that the (built-in) antenna on the AMS meter is a light bulb, shining in all directions, far enough to reach your nearest neighbour. Then you have a reasonably good picture of the area radiated by your AMS meter.

The aim of the shielding measures will then be to stay in the shadow, i.e. to shield so that sleeping and living areas are not in the “lit” zone, nor that “light” is reflected from shielded surfaces to those areas. At the same time, one should not disturb the AMS meter's communication with the outside world: if so done, the meter may increase its transmission power. Often, there are other sources of radiation that should be taken into account, too. There may be mobile base stations (masts) nearby, the neighbour's WiFi and smart meter, etc.

The exposure level, measured as energy intensity, decreases by one quarter when distance is doubled. One should thus map the total electromagnetic load in the home and find the sources, before starting shielding. Either you do them yourself, or you get a professional to do the measurements. Unfortunately, the wrong measuring devices are often used. The measuring instruments must be adapted to the purpose and must be interpreted wisely.

Exposure levels count, but is not the full story. Pulsing that affects biology is mostly *low frequency*. To make shielding “capture” low frequencies, it should be earthed. With the shielding paint, instructions are included as to how to earth the painting or to connect it to the ground wiring. This must be done by knowledgable people, possibly by an authorized electrician.

5.5.1 Common mistakes when using shielding materials

Self-made is not always well-made. Typical errors that can make exposure conditions worse are:

1. Only some screens, e.g. one or two walls in the home, are established to stop the radiation from e.g. an AMS meter, or from a mobile mast seen outside. Other transmitters might radiate from other angles and be reflected by the shielding set up.
2. Floors, walls and ceilings are covered with shielding material, but doors and windows are forgotten. The radiation then enters through doors and windows and is reflected in the shielding materials. This may often worsen the situation.
3. Shielding material is bought without considering its appropriateness to what it should shield against. Different types of shielding material have different functions and properties. It is important to use the right materials.

If you are in doubt about which measures will work best, or have questions related to measuring instruments or shielding materials, you should consult with professionals.

You should definitely not cover the entire fuse box or the AMS meter with shielding materials. This will cause the meter to turn up the transmission power to compensate enough to make contact with the other meters in the mesh network.

5.6 Filter solutions to remove dirty electricity

Some choose to have expensive electrical filter solutions installed on their home's power supply, or on every single appliance in the house. This allows them to limit the amount of electrical noise, even if they use modern electronics with SMPS's.

This is relevant for dirty electricity from battery chargers, computers, TV equipment, modern household appliances, chargers for electric cars, LED bulbs, fluorescent tubes, light dimmers, solar panels, etc.

Noise voltages are usually divided into two different types. They require slightly different types of filter solutions:

5.7 Symmetrical noise and asymmetric noise – and filters

- **Differential mode noise** (also called *symmetrical noise*) is normally best filtered with a capacitor-based filter.
- **Common mode noise** (also called *asymmetric noise*) may be filtered both with ferrites and capacitors.

Common mode noise will radiate out from the wiring network to a greater extent than differential mode noise. It is therefore very important to filter out such noise in an effective way.

In the case of noise in the electrical system, it is important to know where the noise occurs. Is the noise only on the current-carrying wires (phase wires), or does the noise also travel via the *ground cable*?* This is important for deciding what kind of filters to use.

Differential mode noise is almost always the dominant noise at lower frequencies. Differential mode noise occurs

- between two conductors (L1-L2 or L1-N)
- mainly at low frequencies (typically 150kHz – 1MHz)

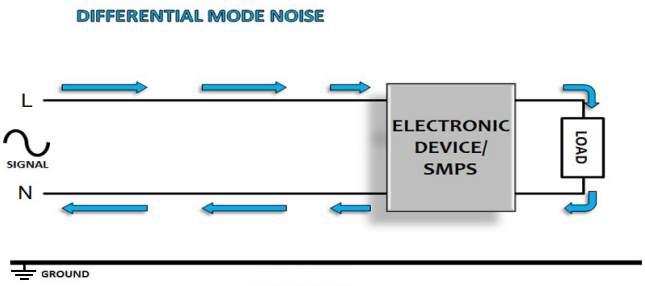

Figure 55:† Differential noise travels along the input line and neutral in opposite directions. The noise may cause damage.

The ground cable is shown at the bottom in each figure as a black line.

*The USA have different meanings for *ground* and *earth*. The *ground wire* is what comes from the electricity supplier, the *earth wire* is literally a connection into the earth providing earth bonding for protection against electric shock. In the UK, *earth* and *ground* are used interchangeably, *equipotential bonding* is the term used for the conductors used for protection against electric shock.

† Diagrams and info are taken and slightly modified, from: https://www.powersystemsdesign.com/articles/addressing-differential-and-common-mode-noise-with-innovative-dual-mode-choke-technology/22/12473

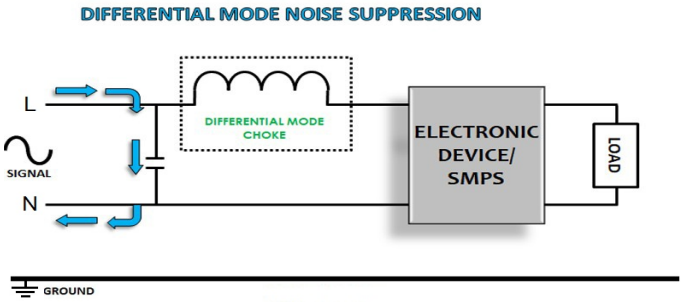

Figure 56: Differential noise, but here with a filter that sends the noise over to the neutral wire.

Capacitor-based filters are effective at reducing differential noise on the lines by "short-circuiting" high frequencies. But such a "short circuit" will cause an extra high-frequency current to flow in the wire between the electrical noise-producing equipment and the filter. This current will generate a high frequency magnetic field.

To avoid this magnetic field spreading in the home, it is therefore important that the filters are placed as close to the noise sources as possible.

Common mode noise occurs mainly at high frequencies (approximately 1 MHz and above). The noise

- occurs between the conductors in a cable and ground,
- but may also come from outside and into the house at lower frequencies.

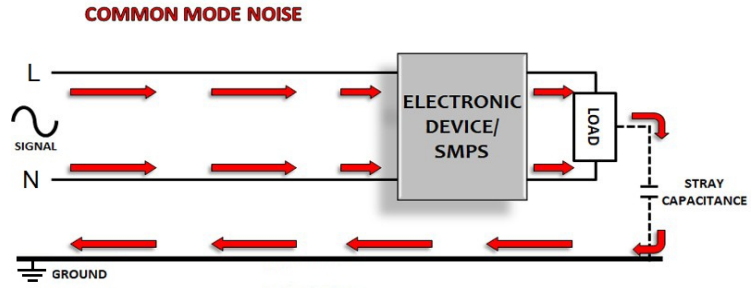

Figure 57: Common mode noise without filter.

The noise travels along wires L and N in the same direction returning through ground via the Ground cable.

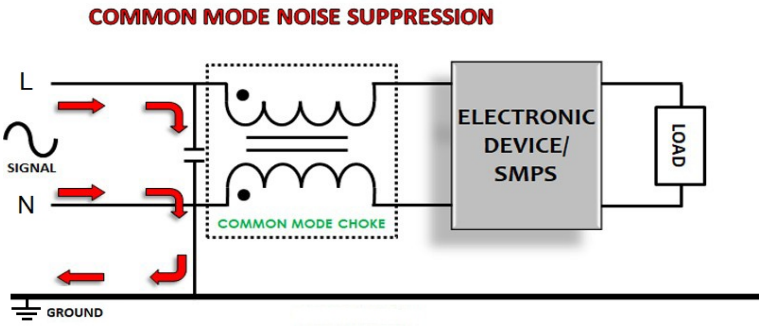

Figure 58: Common mode noise with dual-winding inductor/choke on the live and neutral wires plus a capacitor from line to ground to stop the noise spreading to the ground cable.

Care is taken that the noise does not spread to the ground cable.

To reduce electrical noise coming in from the outside, i.e. from the external power grid, either a single-phase or three-phase *line filter* may be installed, and/or ferrites may be installed on the main input line, located after the electricity meter.

A *line filter* is an electronic filter that is placed between the mains electricity input and internal circuitry of electronic equipment to attenuate conducted radio frequency interference, also known as electromagnetic interference. Inductors/chokes (often called ferrites due to commonly being made from ferrite core material) on the main input line are an effective measure against common mode

noise as they create an impedance for high-frequency signals. The energy is either reflected back into the cable, or is dissipated as weak heat.

When using an electric noise filter, there is a certain risk of making the situation worse. It is important to be aware of this, to avoid creating new problems.

5.8 Important not to create dirty electricity on the ground cable

A problem with capacitor-based filters is that they are connected to the electrical ground in the house to “lead away” the dirty electricity.

However, the house ground wire is also connected to other parts of the electrical system in the house, as the ground wire runs throughout the house. Everything that is grounded and/or connected to the electrical system is thus connected to the ground wire.

The noise/dirty electricity will thus easily be passed on to all grounded wires and appliances and thus radiate from these wires and appliances, using them as antennas. Therefore, use of capacitor-based filters may actually worsen the dirty electricity situation in the house.

A capacitor-based line filter in the fuse box should therefore not be grounded, unless a connection to earth can be established independently of the ground connection in the supply to the home. The ideal would be to bury a copper sheet of 1 x 2 metres, or using the electricity network company's “global ground” – if it is available. Any connection between the home's own *local ground* and the *global ground* must then be broken.

The line filter will reduce noise between the phases regardless of whether it is grounded or not.

5.9 Noise and electrical earth (PE)

All electrical installations in Norway must have an earthing system to protect people and animals against dangerous electrical currents and over-voltages that may occur due to faults in the electrical system or connected equipment.

The earthing is therefore called “protective earth” (PE). In addition to personnel safety, the overall purpose of an earthing system is to minimise potential differences between different earth connections or conductors.

To achieve good earthing in the home, one of the following systems should be used:

1. TN system – A system having one or more points of the supply directly earthed/grounded, the exposed conductive parts of the installation being connected to that point by the PE conductor. The N and PE conductors can be combined (TN-C), kept separate (TN-S) or partly combined (TN-C-S). TN-S systems are commonly used for residential systems particularly in Europe.
2. TT System – The supply is earthed/grounded at source but the exposed conductive parts of the installation require the consumer to provide earth electrodes. (Preferred system for the interference-free earthing.)
3. IT System – The supply is isolated from earth/ground and the exposed conductive parts of the installation require the consumer to provide earth electrodes. (This system is uncommon.)

Where earth electrodes are required, these are dug into the ground or drilled into the rock and take the form of a spiked copper rod (maybe 1.5m long and 1cm in diameter), a large copper plate

(maybe 1m x 2m x 5mm) or other suitable underground metalwork. Their embedded depth needs to be such that the soil drying or freezing shall not increase its resistance above the value required for it to remain effective. Special earthing mortar may be appropriate. (Please refer to your regional electrical installation regulations for size and resistance values.) The electrode(s) are connected to the main earthing terminal for the PE conductors within the cables to the sockets, equipment and appliances.

As common mode noise today often contains *high-frequency components*, it is recommended to use a multi-wire earth cable with a minimum cross-section of 25 mm^2 intermediate earth electrode and main earth clamp/rail.

Where there is a lot of high-frequency common mode noise you want to remove from the home's grounding system by the use of a line filter, you may need to improve the grounding. In such cases, it might be a good solution to bury a large copper plate, the bigger the better and preferably 1 x 2 metres, to which the multi-wire ground wire is connected.

If there is an earth cable from the supplier leading into the home, a good measure could be to connect this to the filter's earth and then break the connection between this and the home's own local earth. In this way, the asymmetric noise that the filter picks up will be directed out of the home and back to the local electricity network substation, so that you don't have to “contaminate” the PE conductors inside the home.

5.10 A little more about capacitors, coils and ferrites

Here is a little more explanation for non-technicians as to how filters based on capacitors and ferrites work. (Sources here are Wikipedia articles and various textbooks in electronics.)

5.10.1 Capacitors

Capacitors are familiar components within electronics. A capacitor does not let direct current through. Only regular alternating current and random dirty electricity in the form of pulses will pass. The peaks of the pulses are reduced, but they continue to happen just as abruptly and with the same frequency as before passing through.

Simply explained, a capacitor consists of two metal plates close to each other with a weak/non-conductive material (dielectric) between them. (See Figure 59.)

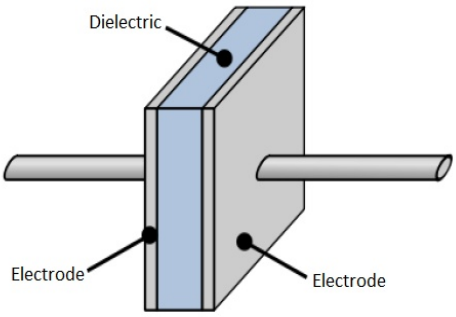

Figure 59: A plate capacitor with two electrodes with a non-conductive (dielectric) medium in between.
Source: https://no.wikipedia.org/wiki/Fil:Plate_Capacitor_DE.svg

Capacitors may be used to capture the peaks of dirty electricity pulses. A capacitor's ability to “capture” the peaks depends on the frequency: Capacitors have different abilities at different frequencies.

5.10.2 Inductors: Coils and ferrites

Simply explained, coils are wires wound in a spiral, e.g. wires wrapped around ferrites. (See Figure 61.) Ferrites are “doughnuts” of a special ceramic composite material. The wires are threaded through the hole and around the outer edge a number of times. Coils let through both direct current and regular alternating current including occasional dirty electricity in the form of pulses, but coils dampen the pulses and they reduce the rate of rise and fall.

Many people working with electricity are familiar with filtering using capacitors. The use of ferrites is by far less well-known. Differential mode currents and voltages are normally filtered well with capacitors, but capacitors are far worse at capturing common mode currents and voltages. Those are best filtered with ferrites. Coils have a braking effect on pulses by means of induction: The current flows through the wires wrapped around the ferrites. When the current changes, a magnetic field is created in the ferrite. This magnetic field then induces a current back into the wire again – but in the opposite direction.

Figure 60 demonstrates this point: As the current increases in the coil, the magnetic field builds up, creating an electric current in the opposite direction to the current in the wire, i.e. it counteracts the increase. When the current is reduced, the magnetic field induces current in the same direction as the current in the line and thus counteracts the reduction. That means: Changes in the current are dampened by the coil.

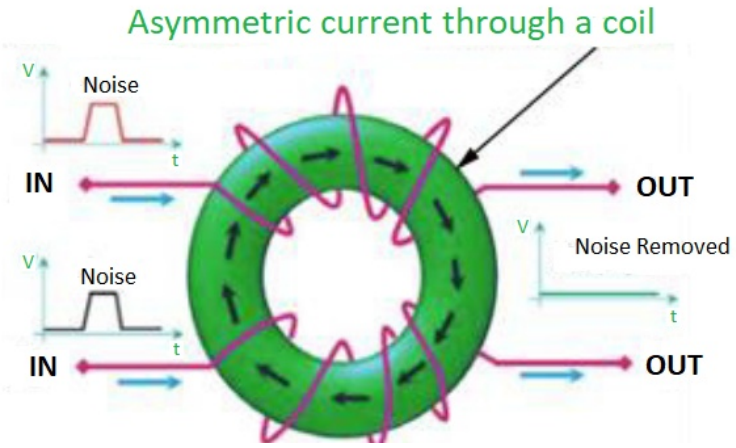

Figure 60: How dirty electricity (noise) is removed when the wires are wrapped around a coil and common mode current passes through the wires.

Figure 61: Different types of coils and different types of ferrite rings.
(Left picture: https://no.wikipedia.org/wiki/Fil:Electronic_component_inductors.jpg)

While some people benefit greatly from filters assembled from capacitors and mounted in the fuse box, for others this is not sufficient to remove the dirty electricity making them ill. It is then necessary to improve the filters with ferrite coils, possibly also having filters elsewhere in addition to the fuse box.

Ferrites are composite materials used to make coil-based filters. Ferrites belong to a rather complicated part of electro-physics about which few people are knowledgable. However, there is information and expertise to be gained from radio amateurs and engineers within the amateur radio

community. They are troubled by noise from dirty electricity and take great care to create good quality far reaching radio signals.

Erik Avnskog, a former sound studio manager before becoming highly EHS, has summed up his own and other radio amateurs' experiences. He has tested several different filters on people who suffer from significant health problems from dirty electricity. Over time, he has identified types and combinations of ferrites which may be used to remove the various high frequencies coming from dirty electricity often found in modern homes. The frequencies can be measured and the effect of the filters can be checked with spectrum analysers.

Nobø AS, a Norwegian manufacturer of wall mounted electrical panel heaters, previously produced a filter with both capacitors and ferrites. This filter has been shown in some tests to be the best solution for removing dirty electricity in homes. Nobø's combination of ferrites and capacitors made this filter an excellent construction which seems not to create new problems. It therefore appears to be the best general solution until now for those afflicted with EHS. However, this filter is no longer produced, but it is to be hoped that someone will be able to start production again.

In addition to such a general solution as the Nobø filter, individual adaptations must be made by trial and error to suit the individual's situation, and based on the types and combinations of electrical devices that are connected to the electrical system, both because dirty electricity produced by different electrical equipment is different, and because the combinations of dirty electricity form interference that will be different depending on what is connected in the specific house (and on changes made).

Figure 62: The Nobø Filter, the ferrite part on the left and the capacitor and fuse part on the right.

When making filters based on ferrites, one must investigate and try out which combination of ferrites and how many times the individual power line must be passed through and around the ferrite to obtain optimal filtering: Too many or too few rounds of the wire may produce poorer results.

Figure 63 below shows an example of the properties of ferrites to dampen high frequency dirty electricity, depending on how many times the wire is threaded through the ferrite ring. *The complexity shows by itself that it is far more fruitful to remove dirty electricity at the source than to remove it in the electrical system.*

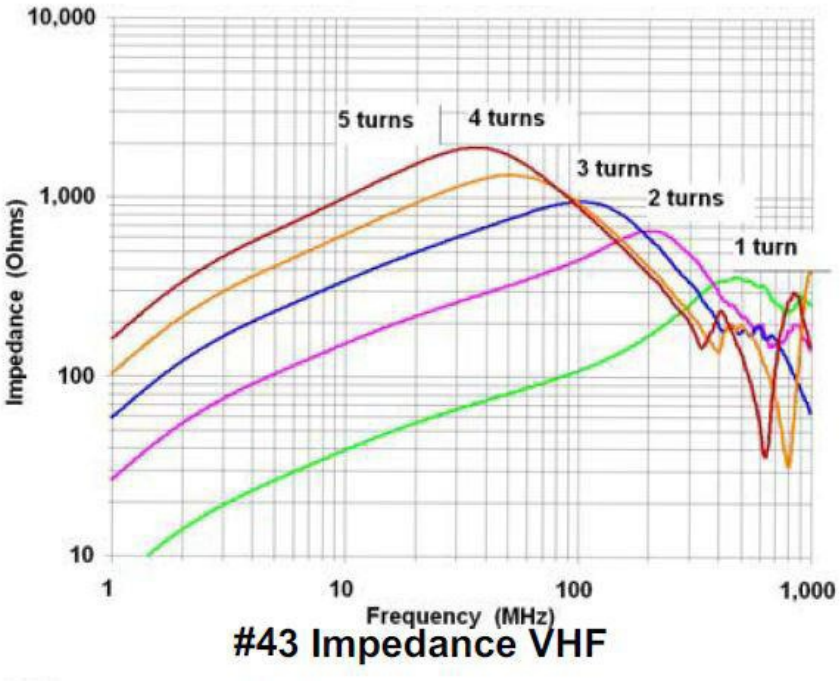

Figure 63: Attenuation capability of ferrite type #43 for different numbers of passes ("turns") for frequencies 1 to 1000 MHz. Note axes are logarithmic.

6. Exposure limits and regulation

Here, exposure limits and regulation are treated as a topic partly independently of the AMS meters. Emphasis has been placed on showing that the prevailing regulatory regime is based on assumptions that have been well proven to be extremely inadequate. We state that radiation protection based simply on the ICNIRP guidelines for avoidance of acute thermal damage, as is the case in Norway and many other countries, is based on professional traditions that are blind to new research:

The radiation protection authority's recommended exposure limits simply lack *predictive power*. As they cannot predict when and how even well-proven damage occurs, they are not suitable for radiation protection.

Furthermore, it is shown that we in Norway practice an interpretation of the ICNIRP guidelines that does not follow from the ICNIRP guidelines, it is in contradiction with them, as well as with the scientific knowledge base.

Thus, in a societal perspective, we are facing a *system failure*. Explanations are given as to the kind of "inner logic" that protects it. It is also shown that this failure has major consequences for what should be considered safe distance from a transmitting source, and thus for health risk assessments – both in connection with AMS meters and other sources of "weak" (i.e. not-heating) non-ionizing radiation.

6.1 Technical and health-related exposure limits – and areas of responsibility

Here, exposure limits based on heating are discussed, and that environmental issues seem to attract little attention.

Most countries have statutory exposure limits specifying maximum permitted emanating power, or *energy intensity output,* for intentionally emitted electromagnetic signals from transmitters. They also have limits for unintended electrical noise (dirty electricity) from electrical and electronic equipment. There are extensive technical standards on these topics, not the least to ensure that devices do not interfere with the functionality of other devices. (This field is commonly labelled "EMC" – for ElectroMagnetic Compatibility.) There is an extensive regulatory apparatus within this field in the form of public administration bodies, laws, regulations and approval schemes.

In Norway, NKOM – The Norwegian Communications Authority – regulates radio communication. Like most European countries, Norway previously had its own national test and approval authority for electrical devices (NEMKO). Simply described, this has been discontinued in favour of the EU's CE and other international approval schemes.

For public health as well as for the health of individuals, however, it is not what emanates from the transmitters, but what is of biological relevance and how much is received, i.e. *the exposures,* that matter:

Radiation protection must ensure that exposure to electromagnetic signals does not threaten public health and work environments, as well as individuals. An outer framework also for technical regulations is set by general exposure limits for humans: E.g., the so called "free use regulations", to which AMS meters and other non-licensed equipment with transmitters are subject, must contain restrictions that ensure proper radiation protection of humans and the natural environment, not just to protect technical devices.

Standards for exposure are set and managed via several “supply chains”. Thus, the Norwegian Labour Inspection Authority administers certain absolute radiation exposure maxima for working life based on EU standards. CE certifications shall ensure that exposure from technical consumer devices do not exceed CE and other absolute limits, while DSA – the Norwegian Directorate for Radiation Protection and Nuclear Safety – has administrative responsibility for radiation protection for the population, recommending exposure maxima (calculated by the use of values and formulas given in guidelines).

The following paragraphs are – with minor adaptations – taken from

> Ref. 201: Flydal, E: Who decides if your WiFi router is a health hazard? – The labyrinth leading to Tordenskjold's soldiers*, blog post 20.01.2017, https://bit.ly/3m52G2X†

The text shows that the responsibility for radiation protection related to consumer equipment not exceeding CE and other standards for emissions, lays with the Norwegian radiation protection authority, DSA, but that the very same DSA has, through *the radiation protection regulations*, renounced dealing with such technical devices as long as their exposures are below the limits recommended by ICNIRP. Hence, the exposure limits are protected from being challenged by these devices making people ill:

> Technical equipment is subject to the *Product Control Act*. Together with the *Product Liability Act*, the Product Control Act regulates the production and sale of products, including consumer electronics, also with regard to possible health hazards. The Product Control Act is administered/enforced by the *Ministry of Climate and the Environment*, which of course has no expertise in radiation protection. Hence, the Product Control Act states that a product is OK when it is in accordance with the applicable regulations and rules (Section 3b).
>
> Whether the product is in accordance with regulations and rules is determined by the regulations regulating the topic in question. The topic that is relevant for wireless transmission equipment, etc., is *exposure to non-ionizing radiation*. Non-ionizing radiation is regulated by the *Radiation Protection Regulations* (as well as various electrical regulations which we may ignore in this context). The Radiation Protection Regulations state (Section 2e) that consumer products are not subject to these regulations' provisions when the exposure limits are complied with.
>
> Proposed exposure limits have been set by *ICNIRP 1998*, and since March 2020 by the *ICNIRP 2020* major overhaul of the guidelines. As mentioned above, this is a set of guidelines with proposals for recommended *reference values* to be used as a basis for deciding on exposure limits. These guidelines aim to protect against *acute warming* (at low frequencies: sensory stimulations and hallucinations), *based on the dogma that damages from weaker exposure* (non thermal levels) *have not been definitively proven.*
>
> The national radiation protection authority, DSA, only *recommends* exposure limits for exposure of *the general population*, not for particularly vulnerable groups or situations. The limits recommended are the values that ICNIRP has calculated (and in practice coordinated

* “Tordenskjold's soldiers”: an expression denoting the same group of people repeatedly taking charge and filling multiple roles. (A reference to the surrender of the Swedish city of Marstrand in 1719 achieved by the Dano-Norwegian commander Peter Wessel Tordenskiold.]

† (Norwegian text) Flydal, E: Hvem avgjør om din WiFi-ruter er helsefarlig? – Labyrinten fram til Tordenskjolds soldater, blog post 20.01.2017, https://einarflydal.com/2017/01/20/hvem-avgjor-om-din-wifi-ruter-er-helsefarlig-labyrinten-fram-til-tordenskjolds-soldater/

with the US standardization organization the IEEE) to ensure that the exposure does not lead to *harmful and acute tissue heating*.

At the same time, the Ministry of the Environment, which is responsible for product control, points back to DSA for all such questions belonging to this management area which DSA has waived.

By this arrangement, the radiation protection authority has freed itself from the responsibility of keeping track with health effects from the flow of communication devices and other equipment with "weak" electromagnetic fields of all sorts. We can only guess that this arrangement will also be found in other national governments.

Still, all arrows point back to DSA, which should have been the agency in charge. The description above also underscores that we do not have exposure *limits*, only *recommendations* not to exceed the reference values, and so to protect only against *acute thermal damage*. Through its regulations, constructed gradually from proposals elaborated by the agency itself, the radiation protection authority seems to be exempt from any responsibility in the area of radiation protection as long as acute thermal damage is out of the question, which – in practice – it *always* is in the context of the general population, as will become clear from later points.

6.2 The exposure limits for the general population

Here follows an overview of the differences in exposure limits in "ICNIRP countries" and a number of other countries.

It is often said that almost all countries of the world "follow ICNIRP's guidelines". This is a greatly exaggerated claim:

Norway and the rest of the Nordic countries, the USA and some other NATO countries have exposure limits set *equal to* ICNIRP's guideline values for protection against damage from heating, with no further restrictions.

As shown in Figure 64, there are huge differences as to the exposure limits to "non-ionizing" radiation in different countries. The great divide is between Western states, notably the USA and its NATO allies, on the one hand, and large states with a history of extensive research in the field, such as Russia, India, and China. Their exposure limits are in general hundreds of times lower than the above-mentioned countries.

As to the former Eastern European countries, they used to follow the Soviet Union, but the picture today is more unclear to us.

Italy, Switzerland, Israel, Cyprus and many other states do to various degrees formally adhere to the ICNIRP guidelines, but with several extra restrictions, e.g. as to the use of WiFi in schools, as to maximum exposure at specific frequencies, etc. Accordingly, their exposure limits are, in general or at specific areas or in specific regions, hundreds of times lower than the aforementioned countries.

(Recommended) limits for several countries and regions, with more details, are reproduced from the WHO in a Norwegian literature review of 2012:

> Ref. 202: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012 page 168 ff., https://bit.ly/3Cu9IDW*

* Original title: "Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis", (Norwegian with English summary). Full link: https://www.fhi.no/globalassets/2012-3_mobilstraling

6.3 The exposure limits in countries that follow ICNIRP's thermal approach

Here follows more about thermally based exposure limits and averages.

According to the ICNIRP foundation's guidelines, the maximum recommended exposure level is calculated as *an average over time* – 6 or 30 minutes, depending on various factors – and as an *average over a surface* (measured as mW or µW over 1 cm^2 or 1 m^2), parts of body or full body. This method of calculation is based on the assumption of *tissue heating* being a sufficient criterion for identifying health issues, as well as assumptions as to which average temperatures trigger tissue damage, and on assumptions about the ability of body tissues to absorb, transport and dissipate heat.

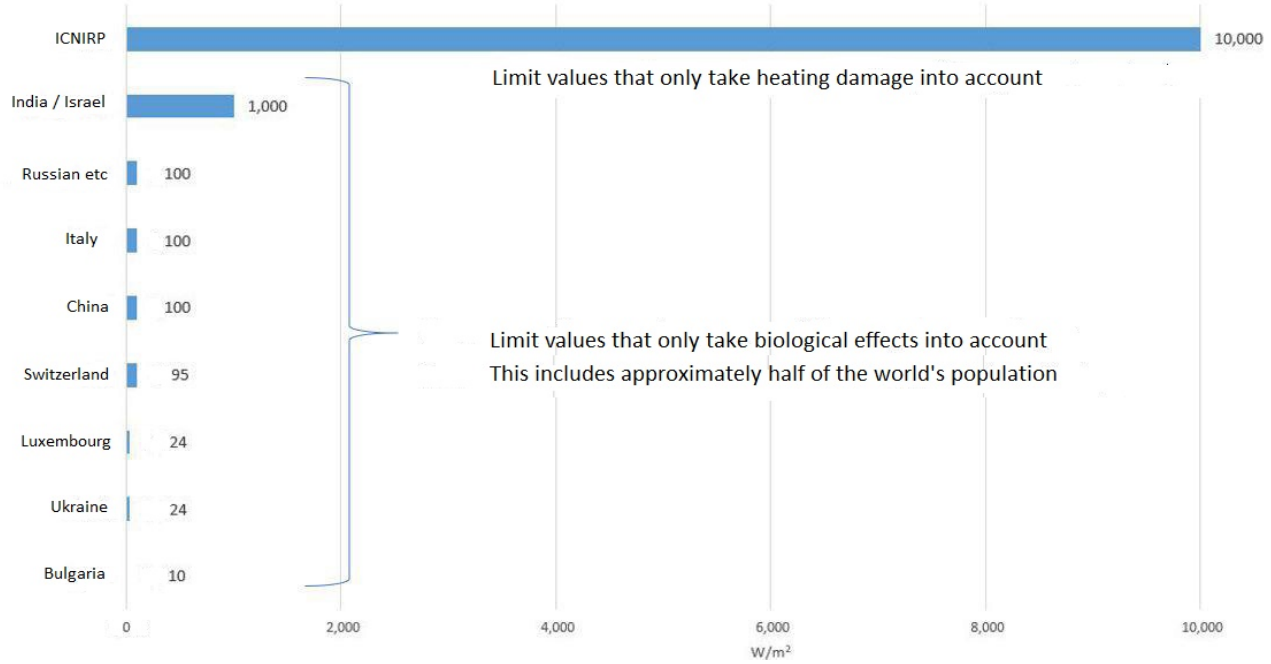

Figure 64: The exposure limits (in W/m^2) for electromagnetic radiation from wireless communication in various countries at frequencies around 1 GHz. The uppermost column shows ICNIRP's recommendation as from ICNIRP's guidelines of 1998. ICNIRP's newer guidelines from March 2020 recommend laxer exposure limits allowing for significantly stronger short-term overall exposures than shown here. (Graph: E. Nordhagen)

The historical origin of this method of calculation is found in the US Navy's – and other branches of arms' – need for protection against *acute burns*, from radars mainly, and the desire not to have to take responsibility for injuries appearing after some time, possibly after end of service. Research was carried out on a handful of apes, dogs and rats, and exposure limits set where they became "uninterested", not to speak of "cooked". Calculations based on energy absorption and dissipation capacity were applied to "SAM", a standardised, large, healthy, adult, US military (white) male doll and the concept of SAR (Standard Absorption Rate) was developed. This "tradition" has since been followed and refined. Most people are significantly smaller than SAM and will thus be more strongly affected, in some cases a lot more strongly, such as e.g. infants.

Ref. 203: Maisch, Don: The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, PhD thesis, Univ. of Wollongong, 2010, http://www.emfacts.com/the-procrustean-approach/

Ref. 204: Paul Brodeur: The Zapping of America, Norton & Co, N.Y., 1977

Ref. 205: Jacobsen, Eva Theilgaard: “SAR, SAM, Schwan and the Nazi connection“, Medlemsbladet, EHS-foreningen, June 2020*

Because this method of calculation is based on averages, it leaves room for very high *point-wise*, *short-term pulses*, which do not contribute significantly to over all tissue heating. As to thermal effects, it makes sense to assume that the *pulse peaks* – i.e. the microseconds with the most powerful energy – will be most bioactive. In line with this, ICNIRP's recommendations specify a ratio of 32 between the average and peak values (see Sections 3.10 and 3.11 about *PAPR* and *Crest factor*). This means that without violating the ICNIRP's thermally based recommendations, one can be exposed to pulse peaks 32 times higher than the average exposure limit, without having acute, harmful health effects that are manifest, solidly proven and generally accepted:

Ref. 206: ICNIRP, 1998. “ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic And Electromagnetic Fields (UP To 300 GHz)”, Health Physics 74 (4):494-522; 1998, https://bit.ly/2GQORiO†, table 6, note 5, page 511:

“For peak values at frequencies exceeding 100 kHz see Figs. 1 and 2. Between 100 kHz and 10 MHz, peak values for the field strengths are obtained by interpolation from the 1.5-fold peak at 100 kHz to the 32-fold peak at 10 MHz. For frequencies exceeding 10 MHz it is suggested that the peak equivalent plane wave power density [a term in wave theory, among others], as averaged over the pulse width, does not exceed 1,000 times the S_{eq} restrictions, or that the field strength does not exceed 32 times the field strength exposure levels given in the table.”

It has emerged from earlier parts of the book, and will also appear in later parts, that heating as a criterion for determining the exposure limits is highly insufficient, also with regard to pulsing: *Pulsing has biophysical action pathways that obviously cannot be linked to heating.*

We have for example mentioned effects on collagen from weather pulses at very weak energies. Likewise, there is an extensive literature on how a number of biological functions, including immunity and mutations, are affected by nature's electromagnetic fields at extremely low strengths, in complex interactions, e.g. timing functions in DNA. See e.g.

Ref. 207: Zaporozhan, V., & Ponomarenko, A. (2010). Mechanisms of geomagnetic field influence on gene expression using influenza as a model system: basics of physical epidemiology. International journal of environmental research and public health, 7(3), 938–965, https://bit.ly/3krn7GU‡

All the way back in 1971, researchers had chosen the concept of *information value*, in order to explain such significant impacts as seen from weak pulses, occurring without heating being part of the picture:

Ref. 208: Presman, A. S.: “Electromagnetic Fields and Life“, English edition: Springer science+business media LLC, New York, 1970

The concept of information value has been underpinned by later discoveries: E.g., researchers have found some migratory birds' navigation to be based on proteins in which quantum biology is used to sense the inclination of the globe's magnetic field:

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* (Danish), original title: “SAR, SAM, Schwan og naziforbindelsen”

† Full link: https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

‡ Full links: https://doi.org/10.3390/ijerph7030938, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2872305/

Ref. 209: McFadden, Johnjoe & Al-Khalili, Jim: Life on the edge, Broadway books, New York, 2014

(For an extensive 2022 update on research on non-thermal, biological effects from "weak" exposure and pulses, as well as an extensive literature review, see

Ref. 209b: Panagopoulos DJ (Ed.). (Dec 30, 2022). Electromagnetic Fields of Wireless Communications: Biological and Health Effects (1st ed.). CRC Press. Doi: 10.1201/9781003201052, https://bit.ly/3KA22ol[*])

These findings show that the impact potential from man-made EMF is overwhelming, even without heating effects.

It would be sensational and absurd if the instances behind the present exposure limits were to deny these findings. What they have done and do instead, is creating *institutional mechanisms to ensure maximum room for action by defining away all misgivings*, as seen in the following paragraphs.

6.4 Practice in "ICNIRP countries" varies – without violating the ICNIRP guidelines

Here it is shown that the ICNIRP's guidelines do not at all prohibit biologically based exposure limits, but make arrangements to prevent them.

By *biologically based exposure limits*, one understands exposure limits that aim to protect against health (and environmental) effects caused by other factors but heating.

As mentioned above, several countries "adhering to ICNIRP" have exposure restrictions in practice meaning that they have set stricter exposure limits. E.g. France restricts the use of WiFi and mobile phones in the school system by law.

Ref. 210: Law no. 2015-136 of 9 February 2015 on limitation, transparency, information and consent regarding exposure to electromagnetic waves, https://www.legifrance.gouv.fr/[†]

In France, Spain, the Netherlands and Italy, there are court rulings which imply the acceptance of increased health risks from exposures below the maximum exposure values recommended in ICNIRP's guidelines for radiation protection, set only to protect against heating.

See for example an account and legal sources from a case on health impact from mobile towers in the Netherlands:

Ref. 211: Flydal, E: Breakthrough in Dutch law on health risks from radiation weaker than ICNIRP's exposure limits, blog post 31.12.2020, https://bit.ly/3Z97G54[‡]

As to France, see a judgment (out of several) ordering the removal of communication from AMS meters, which in France communicate via the power grid, i.e. as dirty electricity:

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* Full link: https://www.routledge.com/Electromagnetic-Fields-of-Wireless-Communications-Biological-and-Health/Panagopoulos/p/book/9781032061757

† Law n° 2015-136 du 9 février 2015 relative à la sobriété, à la transparence, à l'information et à la concertation en matière d'exposition aux ondes électromagnétiques

‡ (Norwegian, with links to Dutch sources) "Gjennombrudd i nederlandsk rett om helserisiko ved stråling svakere enn ICNIRPs grenseverdier", full link: https://einarflydal.com/2020/12/31/gjennombrudd-i-nederlandsk-rett-om-helserisiko-ved-straling-svakere-enn-icnirps-grenseverdier/

Ref. 212: “Smart Meters: the ordeal of an EHS”, L'age de faire, May 2018*

These countries “adhere” to ICNIRP by using ICNIRP’s reference values for thermal damage as recommended exposure limits. Their legal systems have nonetheless come up with verdicts and their governments have made decisions implying that health risks resulting from weaker, “sub-thermal” exposure intensities are also recognised.

Language in technical standards is extremely compact and significant points may follow from seemingly insignificant wording. Hence, it is not normally noted that it is fully acceptable within the ICNIRP guidelines – both those from 1998, 2002 and from 2020 – to conclude that damage may occur also from sub-thermal exposures:

The guidelines state that the users of the guidelines are themselves responsible for making an overall assessment, assessing the state of knowledge and, based on such a review, assessing whether there is scientific knowledge for setting exposure limits different from those derived from ICNIRP guidelines and from ICNIRP's recommendations.

It is therefore completely within reason to adopt stricter exposure limits than ICNIRP's reference values:

> Ref. 213: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002, p. 545, https://bit.ly/3NblHMT†:
>
> “If available data permit the identification of an adverse effect, but not the detection of a threshold, other risk reducing strategies may be employed. The role of ICNIRP as a scientific advisory body would be to analyze the risk in terms of levels of consequences that could be quantified. The acceptability of such risks would, however, be based also on social and economic considerations, and, as such, fall outside the remit of ICNIRP. National authorities responsible for risk management may provide further advice on strategies to avoid the effect or limit the risk.”

However, the ICNIRP 1998 guidelines state that current knowledge is that the purely scientifically (and thermally) based limits are enough to protect against any (non-static) EMFs (italics applied for emphasis):

> Ref. 214: ICNIRP, 1998. Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz). Health Phys 74:494-522, pp. 494-495, https://bit.ly/2GQORiO‡:
>
> “In establishing exposure limits, the Commission recognizes the need to reconcile a number of differing expert opinions. The validity of scientific reports has to be considered, and extrapolations from animal experiments to effects on humans have to be made. The restrictions in these guidelines were based on scientific data alone; *currently available knowledge, however, indicates that these restrictions provide an adequate level of protection from exposure to time-varying EMF*.”

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* “Compteurs communicants: le calvaire d’une EHS”, link no longer available, (April 2023). For a translation to Norwegian and comments, see For oversettelse til norsk: se i Flydal, E: AMS, radiobølger og skitten strøm: En fransk historie, bloggpost 07.01.2021, https://einarflydal.com/2021/01/07/ams-radiobolger-og-skitten-strom-en-fransk-tragedie/

† Full link: http://www.icnirp.org/cms/upload/publications/ICNIRPphilosophy.pdf

‡ Full link: https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

By 2020, ICNIRP has modified its attitude slightly, while still basing its guidelines on thermal damage, it recognizes that there may be relevant limitations to this knowledge (italics applied for emphasis):

> Ref. 215: Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, May 2020, Volume 118, Number 5, DOI: 10.1097/HP.0000000000001210, https://bit.ly/3maoRoo*:
>
> Page 483, Column 1-2:
> "Although these guidelines are based on the best science currently available, *it is recognized that there may be limitations to this knowledge that could have implications for the exposure restrictions*. Accordingly, the guidelines will be periodically revised and updated as advances are made in the relevant scientific knowledge."

The ICNIRP 2020 guidelines also moves the battlefield to the issue of proof: *When is evidence good enough to deserve recognition*? After first demanding very strict criteria for any empirical evidence to be accepted as sufficient proof, it also opens for acceptance when less strict criteria are satisfied (italics applied for emphasis):

> Page 484, column 2:
> "The reliance on such evidence in determining adverse health effects is to ensure that the exposure restrictions are based on genuine effects, rather than unsupported claims. However, *these requirements may be relaxed if there is sufficient additional knowledge (such as understanding of the relevant biological interaction mechanism) to confirm that adverse health effects are reasonably expected to occur*."

In addition, ICNIRP 2020 makes gross reservations as to harmful effects on implants made of metal or interference on electronics, as well as reservations as to any damages not appearing as indisputable and evident, or not having an unambiguously proven cause – which is a normal state of affairs in biology as well as in medicine.

This has been reviewed in

> Ref. 216: Einar Flydal, Else Nordhagen and Odd Magne Hjortland: ICNIRP's new guidelines for radiation protection are based on professionally untenable documentation, allow for stronger exposure, weaken authorities' and consumers' control options, and legitimise increased health and environmentally harmful infrastructure, such as from 5G, note, 21.05.2020, https://bit.ly/3ZbHUNK†

By making such admissions and exceptions, ICNIRP seems to aim at maintaining the notion of the thermal paradigm being legitimate and sufficient for setting EMF exposure limits, while not directly denying non-thermal effects. In this way, it is left to the academic battlefields, lobbies and political pressure to decide what to include or exclude of non-thermal effects.

The above are mentioned in an extensive literature review by Dr. Dimitris J. Panagopoulos, which reveals that the health impact potential from man-made EMF is overwhelming, even without thermal effects.

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* Full link: https://www.icnirp.org/en/publications/article/rf-guidelines-2020.html

† (Norwegian) title: ICNIRPs nye retningslinjer for strålevern er basert på faglig uholdbar dokumentasjon, åpner for sterkere eksponering, svekker myndigheters og forbrukeres kontrollmuligheter, og legitimerer økt helse- og miljøskadelig infrastruktur, som fra 5G, full link: https://einarflydal.com/utredninger-boker-m-m-a-laste-ned-bestille/

Ref. 216b: Panagopoulos DJ (Ed.). (Dec 30, 2022). Electromagnetic Fields of Wireless Communications: Biological and Health Effects (1st ed.). CRC Press. Doi: 10.1201/9781003201052, https://bit.ly/3KA22ol†)

Nonetheless, ICNIRP and its members are highly instrumental in keeping non-thermal effects illegitimate as a basis for setting exposure limits. However, by implication, *governments and other relevant entities may "adhere to ICNIRP" by using thermally based exposure limits as a platform, adding various restrictions to protect against well demonstrated non-thermal effects*, e.g. on the use of certain kinds of radio signalling (WiFi, 4G, 5G, … etc.) in homes, nurseries, schools, hospitals, and so on. Still, a handful of countries do not.

6.5 Norwegian radiation protection: "More Catholic than the Pope"

Here it is shown that the Norwegian government practices a restrictive interpretation of the ICNIRP guidelines which does not actually follow the ICNIRP guidelines and is in obvious conflict with scientific knowledge. (A core of other national governments also follow such a practice.)

As we have seen above, several countries "adhering to ICNIRP" exploit the room for manoeuvre that the ICNIRP guidelines encourage: These countries use the thermally based guidelines as a starting point, adding more restrictive exposure limits for specific frequencies, communication protocols, locations or else, as they recognise the existence of sub-thermal, or so-called *biological damage* from exposure to EMF's. Also, courts make decisions implying an acceptance for biological damage, e.g. in cases of electro-hypersensitivity or of cancer from EMF exposures over time.

Until the introduction of AMS meters, such a practice was not seen in Norwegian government or courts. Instead, the Norwegian Radiation Protection Authority's interpretations of ICNIRP's guidelines, WHO's advice, as well as of the prevailing knowledge is that thermally based limits are sufficient for exposure protection and that there is no knowledge at hand justifying stricter limits.

Norwegian courts have simply referred to the most simplistic interpretation of the ICNIRP guidelines: - "The knowledge base indicates that diagnoses such as microwave sickness/electro-hypersensitivity cannot be rooted in exposure to electromagnetic fields." Also, the literature reviews that governmental authorities refer to (i.a. Ref. 202), are interpreted in that same way: "As no harm has been found, there is no reason for restrictions!"

Several Norwegian rulings exemplify this point:

> Ref. 217: 2007-03-28 HR-2007-607-A-Rt-2007-464 Sør-Trøndelag. Compensation rights. High voltage installations. Exposure beyond the recommended levels. Reduced value and lost development opportunities. Case lost – but plaintiff got legal costs covered.
>
> Ref. 218: 2011, Case 2011/524 Wanted to cancel the contract because of the transformer in the basement. Exposure below ICNIRP levels. Case lost. https://www.aftenposten.no/norge/i/rAqpA/Ma-punge-ut-for-stralfrykt
>
> Ref. 219: 2015, Case 14-103302TVI-AHER/2, Case about base stations located 30m from the house of a radiofrequency radiation specialist. Exposure below ICNIRP levels. Case lost. https://einarflydal.com/wp-content/uploads/2015/03/dommen-25032014.pdf

† Full link: https://www.routledge.com/Electromagnetic-Fields-of-Wireless-Communications-Biological-and-Health/Panagopoulos/p/book/9781032061757

> Ref. 220: The Social Security Court: APPEAL CASE NO. 20/00456: NAV COMPLAINTS INSTITUTE The case of the king's caretaker, who had two mobile base stations right next to his head for a long time and became disabled. Exposure below ICNIRP levels. Case lost. Appeal refused, on the grounds that there was no proven connection between exposure and alleged electro-hypersensitivity or the other symptoms he suffered from.
>
> Ref. 221: The Social Security Court: Ruling TRR-2011-2208 Result: electro-hypersensitivity is not recognised, functional disorder must be assessed. Exposure below ICNIRP levels. Case lost.
>
> Ref. 222: The Social Security Court: Ruling TRR-2014-2880 Result: The patient firmly believes that she has electro-hypersensitivity. This is not a recognised diagnosis and therefore cannot be used to get disability benefits. Exposure below ICNIRP levels. Case lost.
>
> Ref. 223: The Social Security Court: Ruling – TRR-2016-2020 Result: Exposure below ICNIRP levels. Case lost. Conditions for reinstatement not met, application refused.

It is noteworthy that in Order TRR-2014-2880 above, document no. 2, the following remark is given:

> "The court will nevertheless add that if the diagnosis had been ME/CFS or "asthenia", which the GP uses, it would have been based on the AP's (=appellant's) own description of symptoms and complaints. In the court's view, it is reasonable to assume that she has a disabling condition that is permanent. As the case is before the Social Security Court, however, the court does not find grounds to go into this issue in more detail."

Also, in the section just referred to, it is noted:

> "The patient firmly believes that she suffers from electro-hypersensitivity. This is not a recognized diagnosis and therefore cannot be used to get disability benefits."

It is repeated in several of these cases that the plaintiffs themselves want their case to be handled based on a diagnosis of "electro-hypersensitivity". As the diagnosis is not recognised, they do, *for formal reasons*, not meet the conditions for the right to a disability pension. *The plaintiffs lose their case because they insist on a causal relationship that is not recognised by the Social Security Court, and because of a diagnosis – "electrical allergy/electro-hypersensitivity" – which is allegedly not "scientifically based" and therefore not generally recognised in Norwegian medical practice. The reason why it is not accepted, being that such weak exposure cannot have such effects, it is not accepted by WHO, and it is not a symptom registered in the WHO ICD-10 system.*

In countries where biologically based exposure limits apply, health damage from the same exposure could not be ruled out as "impossible" nor being in conflict with the exposure limits.

6.6 National exposure limits based on biological effects

Some examples of EMF exposure limits based on biological findings are shown here.

Setting EMF exposure limits are slow processes. Hence, it is to be expected that exposure limits lag behind what is current knowledge in research, and that present exposure limits are based on old, may be even out-dated, research.

In the preceding section, it has been shown that several countries "adhering to ICNIRP" have exceptions where limits are set stricter. This must be justified, and explained, by the view that biological damage occurring at sub-thermal levels are found and should be taken into account. Going into the details, different assessments may be possible. We have made inquiries to some of these countries as to how they argue in favour of their lower exposure limits, but have had no

answer. However, what they evidently must have in common, is taking several other factors but heating into account, including pulsation.

In Figure 65, we gain insight into some parameters that have been given weight: *the duration of the exposure and whether the signal form is fixed or pulsed*. Figure 65 reproduces a table of the exposure limits around 1980 in the USA and Western Europe versus parts of Eastern Europe:

> Ref. 224: Hecht, K. "The value of cell phone radiation limits", Kompetenzinitiative e.V., 2009, https://bit.ly/3IV3gJG*

Duration per day	Maximum permissible average power density ($\mu W/m^2$)				Signal form
	USA, Western Europe	Poland	Former Czech-oslovakia	Former East Germany	
Full day (in Eastern Europe max. 8 hours)	100 000 000	100 000	250 000	1 000 000	Fixed
			100 000	500 000	Pulsed
Up to 3 hours (Soviet: 2 hrs)	100 000 000	1 000 000	650 000	5 000 000	Fixed
			250 000	2 500 000	Pulsed
Up to 20 minutes	100 000 000	10 000 000	2 000 000	10 000 000	Fixed
			800 000	5 000 000	Pulsed

Figure 65: Exposure limits in the USA/Western Europe and some Eastern European countries around 1980 (Source: Hecht 2018)

The Soviet Union and Eastern Bloc countries therefore had around 1980 – and some of them still have, as far as we know – much lower maximum limits for the general population than found in the USA: set at around one thousandth. Moreover, as Figure 65 also shows, several countries had taken into account that exposure to (low frequency) pulsed radiation has a stronger biological impact, and that this property is neglected by measurements averaged over time and space, as well as by limits based on the radiation's energy intensity alone. Hence, their view that stricter exposure limits were needed against such exposure.

Such biologically underpinned exposure limits use a combination of the energy exposure threshold where the researchers found that the body began to react when exposed, or after a period of time, and the empirical observations that some forms of EMF's are more biologically offensive than others (i.e., *sub-thermal effects*).

> Ref. 225: Michael Repacholi, Yuri Grigoriev, Jochen Buschmann and Claudio Pioli: Scientific Basis for the Soviet and Russian Radiofrequency Standards for the General Public, Bioelectromagnetics, 2012, DOI 10.1002/bem.21742

ICNIRP works via the WHO to push ICNIRP's guidelines as a basis for determining exposure limits. For example, in Poland, Ukraine and India, with arguments that the country otherwise falls victim to "groundless fear" and that international standardization is in the interest of all:

* (German), original title: "Der Wert der Grenzwerte für Handystrahlungen", full link: https://kompetenzinitiative.com/wp-content/uploads/2019/08/hechtgrenzwertekiint20090109.pdf

> Ref. 226: “Clear the air on mobile tower radiation, WHO tells India”, The Hindu, February 19, 2014, https://bit.ly/41kulx4*

We might assume that this “missionary work” is not just about promoting public health, as public health is indeed unlikely to be better protected with more lax exposure limits. More likely, such efforts should be perceived mainly as trade and defence policy advances: The advantage for politics and industry of global, common standards is undeniable, at least for the most powerful parties in such activities. Also, the interests behind getting acceptance for the maximum possible elbow room needed for defence cooperation and for the introduction of new generations of wireless communication, such as 5G, are incontestable.

We underpin this interpretation with the fact that the *thermal paradigm* has been demonstrated over and over again not to be scientifically sound or well founded: It has been demonstrated time and time again in detail that the heating criterion cannot provide adequate radiation protection. This is dealt with above, and will be shown further below. We limit ourselves here to a single paper that specifically addresses this topic:

> Ref. 227: Havas, Magda: When theory and observation collide: Can non-ionizing radiation cause cancer?, Environmental Pollution 221 (2017), pages 501-505, https://bit.ly/3Z8xRJt†

6.7 The thermal dogma is deeply embedded in the measuring method

Exposures are measured by evaluating the heating potential. Here is a warning against the limitations such a method provides.

It is both practical and conventional within the radiation hygiene tradition to state exposures in terms of *the amount of energy that hits per unit area over time*, i.e., how much energy there is in the electromagnetic waves/rays/photons or just “particles” hitting a given area during, e.g., 30 minutes. Based on more or less theoretical and experience-based knowledge as to the respective tissue's robustness as well as capacity for *heating, diffusion and dissipation*, the heating potential from the energy is calculated, and hence, an energy intensity threshold above which damage from the radiated energy is to be expected, can then be set.

(W/m^2, (Watts per square meter) is a commonly used unit for measurements, but a number of variants are in use – such as microwatts per square meter ($\mu W/m^2$) or microwatts per square centimetre ($\mu W/cm^2$). Volts per meter (V/m) or variants of that, as well as milli- or microTesla (mT or µT) are other units used to indicate the energy in electromagnetic energy. For historical and practical reasons, all alternatives are used. One must be aware of which units are used.)

Hence, by convention, exposure limits are set according to the heating potential. Thus, the so called “*thermal paradigm”*, the idea that measuring the degree of acute heating provides an efficient and relevant measuring stick to identify the relevant exposure thresholds, is built into the measuring tool itself. Common suppositions are also that the relationship between the energy intensity of the *exposure* (*the dose*) and the *effect* (*the response*) is positive and roughly linear: When the dose increases, the response will increase as well.

The problem with these conventions and suppositions is that they are too simple or even very misleading for exposures being too weak to cause thermal damage, i.e. damage from overheating. Accordingly, in an article on electromagnetic fields and cancer, Arnt Inge Vistnes, retired from the

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* Full link: https://www.thehindu.com/news/national/clear-the-air-onmobile-tower-radiation-who-tells-india/article5704144.ece

† Full link: https://doi.org/10.1016/j.envpol.2016.10.018

Institute of Physics, University of Oslo, warns that a positive correlation between dose and response may be a hypothesis of quite limited validity:

> Ref. 228: Arnt Inge Vistnes, Department of Physics, University of Oslo, writes in Fra Fysikkens Verden 2 (199) 42-47, 26 June 1999:
>
> "Practically speaking, all studies use the so-called "Time Weighted Average" (TWA) as a measure of exposure, either directly or indirectly (e.g. in the form of a so-called "Line Configuration"). But as long as we do not know the mechanism of action, this exposure measurement unit is only a "first guess", and in the future it may turn out that this measurement unit was an unfortunate choice. Thus there is a real possibility that we would identify a more clearly increased risk of cancer if we used a better unit for the exposure. These are sheer speculations, but nevertheless point at an important uncertainty factor that should not be forgotten."

In fact, "hockey sticks", i.e. U-shaped relationships, as well as "windows" have also been demonstrated, which means that the relationship between the exposure intensity and the strength of the response is not linearly positive, but curvilinear and/or discontinuous. This is not at all captured by ICNIRP's guidelines for calculating exposure limits.

As to biological effects from pulses, patterns are observed where the dose-response connection seems to be *negative*, i.e. that weaker intensity produces a greater effect, or *independent* of the signal strength. Instead, most important contributors are various characteristics of the pulses, like their shape, abruptness, intervals and variations which might create interference with biological processes. Thus, we have to cope with a multidimensional, i.e. extremely complex, inventory of possible factors and combinations of them.

Table 3: Weighted precautionary values for radio frequency radiation

RF source Max Peak / Peak Hold	Exposure per day	Exposure at night	Sensitive populations
Radio (FM)	10.000 µW/m²	1000 µW/m²	100 µW/m²
TETRA	1000 µW/m²	100 µW/m²	10 µW/m²
DVBT	1000 µW/m²	100 µW/m²	10 µW/m²
GSM (2G) 900/1800 MHz	100 µW/m²	10 µW/m²	1 µW/m²
DECT (trådløs telefon)	100 µW/m²	10 µW/m²	1 µW/m²
UMTS (3G)	100 µW/m²	10 µW/m²	1 µW/m²
LTE (4G)	100 µW/m²	10 µW/m²	1 µW/m²
GPRS (2.5G) med PTCCH* (8,33 Hz Pulsating)	10µ W/m²	1µW/m²	0,1 µW/m²
DAB+ (10,4 Hz Pulsating)	10 µW/m²	1 µW/m²	0,1 µW/m²
Wi-Fi 2,4/5,6 GHz (10Hz Pulsating)	10 µW/m²	1 µW/m²	0,1 µW/m²

*PTCCH, packet timing advance control channel.

Based on: BioINitiative (9, 10); Jundi and Hutter (260); Leitfaden Senderbau (221); PACE (42); Seletun Statement (40). 1) Precautionary approach with a factor of 3 (field strength), with a factor of 10 (effectiveness). See also IARC 2013 (24) and Margaritis et al. (267)

Figure 66: Indicative values for precautionary exposure values (EUROPAEMs guidelines 2016)

Exposure limits adjusted for such contributing factors may be set as listed in the table on the left (Figure 66): Recommended maximal doses are suggested in conventional terms as energy intensities (µW/m²), but limits are proposed according to medical doctors' and other therapists' experiences with patients' reactions to the various communication systems of today and their technical "protocols". Pulsing varies with modulation (i.e. encoding) techniques and other parameters, and are more or less biologically intrusive. Lacking understanding of the exact causations is the reason for this method being used.

Figure 66 shows such recommendations for maximal exposures from the guidelines issued by the European environmental medicine organisation EUROPAEM.

> Ref. 229: EUROPAEM Guidelines 2016: Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshammer, Piero Lercher, Kurt Müller, Gerd Oberfeld, Peter Ohnsorge, Peter Pelzmann, Claus Scheingraber and Roby Thill: EUROPAEM EMF guidelines 2016 for the prevention, diagnosis and treatment of EMF-related health problems and diseases (original reference: Rev Environ Health. 2016 Sep 1;31(3):363-97. doi: 10.1515/reveh-2016-0011)

As seen in Figure 66, EUROPAEM suggests recommends maximal levels for different radiocommunication systems, different times of the day and different population groups. These levels are set based on observed biological impact and precaution. The maximum exposure values are hundred thousandths or millionths of the levels stated by ICNIRP. They are often exceeded in today's urban living environment and maybe in most homes.

In addition, the EUROPAEM guidelines provide further recommendations for conditions and parameters not covered by the limits given in the table (EUROPAEM 2016 p. 19):

> "**Precautionary guidance values for selected RF sources**
> In areas where people spend extended periods of time (> 4 h per day), minimize exposure to radio-frequency radiation to levels as low as possible or below the precautionary guidance values specified [in the table]. Frequencies to be measured should be adapted to each individual case. The specific guidance values take the signal characteristics of risetime (ΔT) and periodic ELF "pulsing" into account (258). Note: Rectangular signals show short risetimes and consist of a broad spectrum of frequencies. The current density induced in the human body increases with increasing frequency in an approximately linear relationship (266)."

6.8 Current public exposure limits are agnostic to the effects of pulses

Here, it is demonstrated how the measurement method is blind to a significant cause of health problems: The pulsing seen in all radiocommunication.

Current exposure limits are based – as mentioned above – on measurements of exposed average energy intensity in order to measure *the heating potential*. Hence, they are designed to protect against *thermal damag*e – with a significant safety margin.

In everyday situations, the public's exposure to radio frequency radiation will in practice always be far below the damaging heating threshold. Seen from the viewpoint of the current exposure limits, this signifies that such radiation cannot be harmful.

When seen from the standpoint that connections between sub-thermal exposure and health effects are considered well evidenced, if not proven, the conclusion will be the opposite:

The absence of damaging heating from the radio waves means there must be mechanisms other than heating responsible for the damage: As the exposure limits do not have a predictive ability, it means the measurements do not capture the relevant parameters. This is illustrated here from practical measurements:

Figure 67 shows fairly steady pulses from an Aidon AMS meter. Each pulse is about 20 milliseconds long. The fundamental frequency is very weak and appears almost as a line. With all the "room" between the pulses, the average energy intensity will therefore obviously be very weak, rather close to the fundamental frequency.

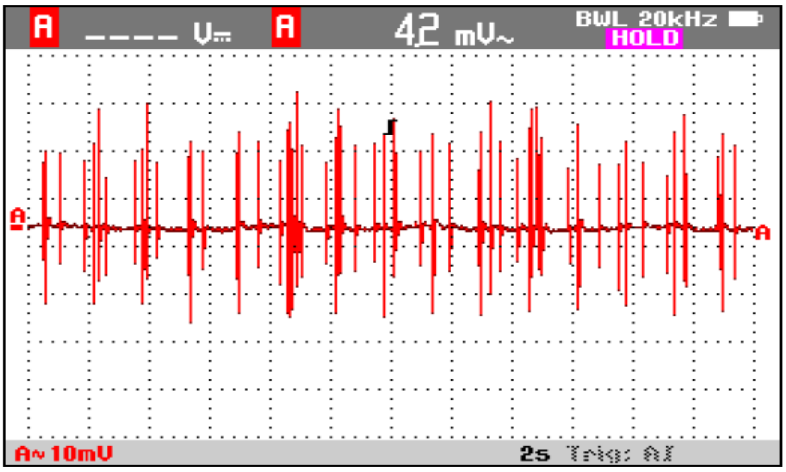

Figure 67: Pulses from an Aidon AMS meter. (Measurement: EMF-Consult AS)

Measurements averaged over time, based on the assumption that heating is what counts, will indicate that no influence can be found.

Figure 68 shows exposures for 18 teachers in Swedish schools from various pulse-modulated (i.e. wireless) sources recorded during the same day.

The measurements show, for example, that the exposures from WiFi (wireless networks in the school buildings) are very weak compared to many of the other sources. We also see that the overall average exposure is around 22.5μW/m^2, while the maximum exposure is significantly higher: at 82,857μW/m^2.

Nevertheless, it seems that it is often WiFi that triggers acute health problems.

This provides an important argument by itself for looking for causes other than the energy intensity.

TABLE 4 | Measurements of 18 teachers in seven schools in Sweden during March 14–November 10, 2016, analyses of all data (microwatts per square meter) by frequency band treating values at detection limit as 0.

Frequency band	Mean	Median	Min	Max
FM	0.7	0.0	0.0	345.7
TV3	0.0	0.0	0.0	147.7
TETRA I	0.2	0.0	0.0	497.3
TETRA II	0.0	0.0	0.0	39.5
TETRA III	0.4	0.0	0.0	910.9
TV4&5	0.0	0.0	0.0	149.0
LTE 800, 4G (DL)	4.1	0.4	0.0	3,285.9
LTE 800, 4G (UL)	4.0	0.0	0.0	82,856.6
GSM + UMTS 900, 3G (UL)	0.2	0.0	0.0	2,874.5
GSM + UMTS 900, 3G (DL)	3.0	0.5	0.0	2,063.5
GSM 1800 (UL)	1.0	0.0	0.0	61,471.1
GSM 1800 (DL)	0.0	0.0	0.0	60.5
DECT	0.0	0.0	0.0	328.7
UMTS 2100, 3G (UL)	0.3	0.0	0.0	43,938.7
UMTS 2100, 3G (DL)	0.7	0.1	0.0	295.9
Wi-Fi 2.4 GHz	2.8	0.3	0.0	4,482.8
LTE 2600, 4G (UL)	0.3	0.0	0.0	3,768.9
LTE 2600, 4G (DL)	1.5	0.0	0.0	608.6
WiMAX	0.0	0.0	0.0	1.1
Wi-Fi 5 GHz	3.1	0.5	0.0	3,321.4
Total	22.5	4.6	0.0	82,857.3

Totally 230,100 readings for each frequency band.

Figure 68: Exposure of 18 teachers in Swedish schools (Hedendal et al 2017)

Ref. 230: Hedendahl LK, Carlberg M, Koppel T and Hardell L (2017) Measurements of Radiofrequency Radiation with a Body-Worn Exposure meter in Swedish Schools with Wi-Fi. Front. Public Health 5:279. doi: 10.3389/fpubh.2017.00279, https://bit.ly/3m9nQx0*

* Full link: https://www.researchgate.net/publication/321166445_Measurements_of_Radiofrequency_Radiation_with_a_Body-Borne_Exposimeter_in_Swedish_Schools_with_Wi-Fi/fulltext/5a12d0f90f7e9b1e572c1378/Measurements-of-Radiofrequency-Radiation-with-a-Body-Borne-Exposimeter-in-Swedish-Schools-with-Wi-Fi.pdf?origin=publication_detail

The thermally based exposure limits found in the ICNIRP guidelines from 1998 are dependent on frequency. For simplicity, as one usually refers to mobile phones and similar frequencies around 1200 MHz to 2 GHz, the limit mentioned is 10,000,000μW/m^2. The radiation to which the teachers are exposed is indeed very low compared to the recommended ICNIRP guidelines, but highly significant based on the EUROPAEM guidelines' recommendations, which are shown in Figure 66. The EUROPAEM guidelines are graded according to reasonable precaution to avoid health impact, established by the six expert sources mentioned below the table.

If pulsing works through completely different mechanisms than heating, and those mechanisms are effective even at very low energy levels and at certain frequencies only, measuring the energy intensity may be quite irrelevant. Such other effects have been documented through a number of studies of the biophysical properties of pulses, discussed in Part 2, Sections 4.2.5 and 4.2.6 of:

> Ref. 231: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3*

Figures 66 – 68 above demonstrate that the probability of being able to detect *thermal damage* from radio communication through an average temperature increase, is vanishingly small – even from today's cacophony of radiation from the many radiation sources in our surroundings. This means – once again – that the measurement method misses well identified mechanisms of action related to pulsing. It would even be the case if an extremely local and short concentration of harmful heating were to occur: The measuring method would distribute the energy over time and area so that only in the most extreme cases could it come close to the recommended exposure limits.

Basal medicine physician Martin L Pall compares the use of averaging in radiation protection to using average calculations on a projectile from a rifle shot. He points out that even pulses of a typical duration of 10 nanoseconds can cause damage, without significantly affecting the average exposure level. Pall gives the following analogy in

> Ref. 232:Seven Repeatedly Documented Findings Each Show that EMF Safety Guidelines Do Not Predict Biological Effects and Are, Therefore Fraudulent. The Consequences for Both Microwave Frequency Exposures and Also 5G, PDF note, https://bit.ly/3mdD9ok†:
>
> "Let's assume that you are concerned about someone shooting you with a high power rifle bullet travelling at about 700 meters per second. The bullet takes about 50 microseconds to tear your body apart. If someone from a regulatory authority tells you that you don't need to worry about that, if you average the force of the rifle bullet over a 21 day period (about 1010 times longer than 50 microseconds), the average intensity is so low, you don't need to worry about it. If someone were to tell you that, you would laugh in their face and state that they are either completely incompetent or completely corrupt. That is exactly the correct response in dealing with the EMF safety guidelines of the EU and other regulatory authorities."

We also see the weakness of using average calculations if we imagine that we were to mark the danger of an electric fence based on the average voltage. This was done as an April Fool's joke about a new directive from the Norwegian radiation protection agency:

> Ref. 233: Flydal, E: New marking of electric fences from today, blog post 01.04.2016, https://bit.ly/3SAJwhy‡ (excerpt):

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* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

† https://multerland.files.wordpress.com/2019/03/martin_pall-5g-euflawsmarch2019-2_version2-1.pdf, cited (in Norwegian) in Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment (5G og vår trådløse virkelighet – høyt spill med helse og miljø), 2019, p. 123.

‡ Full link: https://einarflydal.com/2016/04/01/ny-merking-av-elektriske-gjerder-fra-i-dag/

> “From now on, [the electric fences] must be marked with average power, i.e. the average current sent through the fences to shock animals. ... In a normal electric fence, the shocks can be up to 10,000 Volts. So, they give you a real jolt in the arm when touching such live wires. I'm sure most of us have experienced that as children in the countryside when we were fooled into touching them. ... Most of the time there is no electricity on the fence. The average power is therefore quite low – let me suggest 2-3 Volts, i.e. no more than you get from a flash-light battery.
>
> [The Norwegian Radiation Protection Authority is credited with the following statement in the same April Fool's joke:] – ... we want to harmonize the calculation methods we use to calculate health hazards from electromagnetic fields, ... and this is the calculation method – i.e. the average effect to which the user is exposed – we use when we calculate health risks from mobile phone radiation, wireless routers, smart meters and other devices with electromagnetic fields. We calculate the average over six minutes, and investigate the risk for body tissue to be heated by one degree Celsius over such a period. ... – We are therefore quite confident ... that electric fences do not pose any health risks. We ... use internationally recognised calculation methods which are standard within the industry.“

It is this “internationally recognised calculation method” which is still used by the radiation protection agency and by all governmental agencies following its advice – even when not 1st of April. This method simply seduces the national communications authority, the occupational safety and health authority, the national energy authorities, the national health administration, the health service at large and HSE staffs making their assessments of harmfulness based on methods that are simply fictitious and of negligible prognostic value:

Such methods are extremely unsuitable for assessing health risks as to the population at large, for assessing the credibility of EHS patients, as well as for assessing measures for radiation protection. To work, they must be combined with knowledge as to the biological impacts from different communication systems' signal properties, as in the EUROPAEM's guidelines (Figure 66).

6.9 Demands for proof set to defend interests of business and traditions

Might the underpinning of the thermal paradigm and the accompanying exposure limits for radiation protection be explained as the results of the vested interests of business and professional traditions? At least, such explanations go a long way.

Above we have discussed how historical and self-interest based political reasons may be behind ICNIRP's guidelines being limited to the use of tissue heating as the single cause of damage. We referred to the US Navy's need to introduce exposure limits to reduce acute damages from exposure around radio and radar systems on board, as well as the obvious interests of both the defence and the wireless industry in having large “elbow room”. Other industries, such as all types of media, as well as governments and consumers, also benefit from wireless technologies, and are of course stakeholders – as long as the costs do not become too great.

It follows that many actors have obvious motives for disputing contrary views and playing down – or making invisible – the costs for public health and for the environment. As in other fields where huge interests are at stake, there are many glaring examples of ignorance, research fraud and abuse of power, as well as false or unjustified accusations of dishonest motives. Here follow a set of critical comments:

> Ref. 234: Wright, Nicola: “Downplaying Radiation Risk“, Chapter 23 in Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y., 2017

Ref. 235: Adlkofer, Franz Radiation protection in conflict with science, 2011, Appendix 5 in https://bit.ly/3kzuwUQ*, short note

Ref. 236: Paul Brodeur: The Zapping of America, Norton & Co, N.Y., 1977

Ref. 237: Alster, Norm: Captured Agency, How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates, Edmond J. Safra Center for Ethics, Harvard University, 2015, https://bit.ly/3Y5Nujx†

Ref. 238: Jacobsen, Eva Theilgaard: "SAR, SAM, Schwan and the Nazi connection", Medlemsbladet, EHS-foreningen, June 2020, ISSN: 2596-3767‡

Ref. 239: Environment Health Trust is taking on The Federal Communications Commission, https://bit.ly/3EHGHWt§

Ref. 240: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, 590 pages (Norwegian)** see especially Part 3

Also, there are obvious political motives linked to international defence cooperation for playing down sub-thermal (or non-thermal) effects: E.g., radar technologies may have to be limited by more restrictive exposure limits. In several cases, the Norwegian military forces have been confronted with the problem of staff on board and general population around military installations with health issues stemming from sub-thermal exposures (e.g. "the Kvikk case" and "the Radar case"):

Ref. 240b: "Norwegian Navy's Cover-Up of Birth Defect Cluster Unravels", Microwave News, November/December 1998, p. 4, https://bit.ly/41v8uDf††

Ref. 240c: "Metoderapport Radarsaken", 2006, report on investigative journalists' methods used for articles published in Dagbladet 15,16,17,18,19,20,21,22,23 and 26 June, 3 and 5 July, 15,16,21 and 22 August, 17 and 18 September, 4 October, 4 and 18 December, https://bit.ly/3IWINTR‡‡

There are also evident administrative and commercial motives for lax exposure limits: Free trade is facilitated by harmonization of all kinds of regulations, which in this context would mean to lower the exposure limits to the ones desired by those with the strongest political or market power, and/or the highest impact in the standard setting forums and intergovernmental bodies.

Such factors may help explain that in Norway – as well as in several other countries with little or no research on the topic – radio frequencies exposure limits are directly copied from guidelines for protection *against thermal damage*, provided by the small, private, German foundation ICNIRP, housed with the German Radiation Protection Authority, and marketed via an ICNIRP inspired, loyal and dominated office within the WHO, *The International EMF Project*.

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*Full link: https://ehtrust.org/uploads/PACER-JA-Vol-16

†Full link: http://ethics.harvard.edu/files/center-for-ethics/files/capturedagency_alster.pdf

‡(Danish) original title: "SAR, SAM, Schwan og naziforbindelsen". An article on how the first US thermal based guidelines, and the central role of Hermann Schwan, a German radiation researcher who came to the USA through Operation Paperclip. (A more detailed story of how the first standard came about and Schwan's role is told in Nicholas Steneck: The Microwave Debate, MIT Press, 1984).

§Full link: https://ehtrust.org/eht-takes-the-fcc-to-court/

** Flydal, Einar & Nordhagen, Else (ed.): 5G og vår trådløse virkelighet – høyt spill med helse og miljø, Z-forlag, 2019, https://bit.ly/3IuR5Ub, or https://einarflydal.com/?smd_process_download=1&download_id=76665

†† Full link: https://microwavenews.com/news/backissues/n-d98issue.pdf

‡‡ (Norwegian) https://www.skup.no/sites/default/files/metoderapport/2005-15%2520Radarsaken.pdf

However, it is also possible to find reasons purely linked to the tradition of the radiation hygiene profession, a profession where physics and the physicists' mindset reign. Such a professional environment, as well as the above-mentioned stakeholders, have their vested interests in maintaining their conventions, where the *thermal paradigm* fits well into the picture of "non-ionizing radiation" being *by definition* unable to create any physical change.

A paradigm shift where room is given for explanations that disrupt radiation hygiene's strong anchoring in theoretical physics, accepting that "non-ionizing radiation" is indeed changing matter, would shake the environment to its foundations:

Radiation protection is based on the radiation hygiene tradition within radioactive, X-ray and UV radiation. These are the most energetic electromagnetic rays and the fast absorption of their energy quickly creates burns in tissue. Their strong, damaging effects is well understood and can be explained based on the basic laws of physics. Thus, there is no need to carry out biological experiments to determine whether the rays are harmful or not.

However, to venture into the strange and far more complex world of biology, means to venture into foreign territory where, among other things, one must accept less exact knowledge requirements. No academic tradition makes such major shifts voluntarily. Professional environments are conservative and changes only happen rarely and reluctantly. Some wise scientist has uttered that *paradigm shifts* don't happen all of a sudden because of new knowledge being at hand, but "one funeral at the time".

ICNIRP is concerned that exposure limits have major consequences for those who are affected by them – industry, defence, consumers. ICNIRP therefore states it will avoid recommending unnecessarily restrictive exposure limits. It avoids doing so by setting *very strict requirements for evidence* before accepting a biological effect as a finding relevant for radiation protection. This is, however, as we have seen from the evidence presented above, not a precautionary attitude, although some wiggle room in the calculations as well as so called *reduction factors* are included. On the contrary, this is a way to obtain maximum leeway, as the requirements are set so strictly that only health impacts connected to *clearly identified energy intensity thresholds* are accepted, *which means restricting acceptable evidence to energy intensity* as well as several other parameters blocking against any new findings.

Having thus disqualified all other causations of health damage from EMFs but energy intensity, ICNIRP's method would certainly seem to be justified as ensuring high certainty: If any findings at all live up to the requirements, they will certainly stand out as scientifically well evidenced knowledge.

> Ref. 241: Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, May 2020, Volume 118, Number 5, DOI: 10.1097/HP.0000000000001210, https://bit.ly/3maoRoo*, p. 484, column 1. [Our comments in brackets, italics added for emphasis]:
>
> "To determine these levels [i.e. of mean energy intensity over time and space], ICNIRP first identified published scientific literature concerning effects of radiofrequency EMF exposure on biological systems, and established which of these were *both harmful to human health and scientifically substantiated*. This latter point is important because ICNIRP considers that, in general, reported adverse effects of radiofrequency EMFs on health need to be *independently verified*, be *of sufficient scientific quality* and *consistent with current scientific understanding*, in order to be taken as "evidence" and used for setting exposure restrictions.

* Full link: https://www.icnirp.org/en/publications/article/rf-guidelines-2020.html

> Within the guidelines, “evidence” will be used within this context, and “*substantiated effect*” used to describe reported effects that satisfy this definition of evidence.”

The ICNIRP emphasises in the quote above that when exposure limits are to be determined, very strict requirements should be satisfied before a health effect is accepted and taken into account. Among other things, the ICNIRP recommends that before a health effect should be considered proven, it must be “scientifically substantiated” – which is defined here as “*established by ICNIRP as both harmful to human health and independently verified, be of sufficient scientific quality and consistent with current scientific understanding”*. This does not only mean “manifested and proved to be durable through rigorous scientific method use”, but also that ICNIRP establishes itself in the role of the arbiter, and that counter-claims from any research group ICNIRP regards as authoritative, e.g. itself, should be enough to block the findings that form the basis for revised exposure limits. Thus, for a finding to be taken into account, the ICNIRP requires there is absolutely certain and manifestly damage that ICNIRP cannot go against.

This is a tall order, and it corrupts the ordinary processes of establishing knowledge in science. What does it imply? The downside of setting such strict requirements for knowledge to be considered good enough for action, is that research trials that demonstrate effects must be *exactly* repeated by *several* research groups, they must be “*of good scientific quality*” (which is self-evident, but still opens for endless debates), and the findings must “*be consistent with current scientific understanding*” (of which there are normally several, so who decides?). In addition, it means that effects that develop slowly and can only be verified as patterns over a long period of time, e.g. brain cancer, will not be easily accepted. Such processes become so lengthy before evidence is available, collected and analysed, that the prerequisites – for example, the communication systems – will have changed along the way, making replication of the trials impossible or at least imperfect, and thus its conclusions worthless in front of such rigid claims.

Such requirements therefore become a method not only for solid science, but also for permanently delaying the development and acceptance of knowledge the industry does not want to have on the table.

The strategy of demanding such absolute proof was developed in other industries, and institutionalised there. See e.g. Chapter 6 “Preventing precaution”, pp. 120 ff. in

> Ref. 242: Sheldon Rampton and John Stauber: “Trust Us We're Experts: How Industry Manipulates Science and Gambles with Your Future“, 2008

Such a choice of extremely high requirements for proof – which, among other things, excludes damages that can be expected to come to light at a later date – is a political choice – not a scientific one – and is a child of the business liberalism that developed in Ronald Reagan's USA. It entered the scene as a reaction against the *precautionary principle* for which the environmental movement had gained traction and got into American laws. Today, the precautionary principle is part of the Constitutions in all European countries and part of EU law.

Biology does not work in ways that make such strict demands applicable: *Biological systems*, i.e. life, *are open, dynamic and complex. Biological effects* are so complex and diverse that even when scientists may show a statistical, or even causal, relationship between exposure to electromagnetic radiation and various negative health effects, they cannot explain the causal relationships down to a level of detail built on the fundamental laws of physics. Nor can they prove that the effects are as consistent as the physicists part of the radiation hygiene tradition might demand. Not even can they come up with rigid and simultaneously realistic experiments carried out on humans. If at all possible, such experiments would simply not be legal.

The countries that have lower exposure limits recognise this biological complexity. They therefore recognise *biological effects* from low level exposure as an important supplement to possible thermal damage (or extra nerve signalling as to low frequencies). *Biological effects* occur at far lower energy levels than heating, and thus the exposure limits to protect against such effects, are also set far lower, and may include restrictions as to other parameters but energy intensity only.

6.10 The professional tradition makes itself blind to biological damage

Here, a more science based explanation is given as to how radiation protection's dominant scientific tradition makes itself blind to biological explanations.

Health damage, and impacts which may cause damage, resulting from so-called “non-ionizing” radiation that is not caused by heating is normally called “biological effects” in professional literature. In order to detect such damage, biological investigations may be carried out under more or less strictly controlled conditions. The workings of biology may be described in systems theory terms as *complex, dynamic and open systems*, as stated in the previous sub-chapter. Due to this great complexity and mechanisms, when investigating *biological effects* it is not possible to make investigations with the same high rigidity and with the same precision in the findings as when one is assessing physics. The body is not a precise, mechanistic clockwork system, where each factor can be precisely described and controlled in a mechanical laboratory.

This is a well-known problem: Always and for all empirical studies, any professional will be able to raise doubts by pointing at some weakness in the research findings or the reporting of them – even if they are not significant. It could, for example, be something about the data collection, the laboratory conditions, mechanisms not clearly mapped or proven, missing links in the causal explanation, problems of transferring findings from experimental animals to humans, findings that not all respondents reacted in the same way, etc.

To come around such problems, there are recognised assessment criteria used to certify causation in biological research. Well recognised and much used are the “Hill criteria”, which essentially say that a relation between dose and effect found should be properly evaluated according to a set given set of criteria, in order to test if causation is reasonable.

> Ref. 243: Hill, Austin Bradford: The Environment and Disease: Association or Causation?, Proceedings of the Royal Society of Medicine, Section of Occupational Medicine, President’s Address, Meeting January 14, 1965

However, regardless of which academic tradition is used as a basis, the scientific principle of empirical research applies that no findings are final: There is always a theoretical possibility that a finding can be disproved. Theoretical derivations based on natural laws or mathematics are thus always more robust than conclusions based on empirical findings, although their relation to the real world might be less solid. Empirical findings can always, no matter how certain the finding is, be attacked because the finding “*has not been definitely proven*”. That the finding “has not been definitely proven” is an argument we find used time and time again against biological findings, not only when it comes to radiation protection. It is an argument which is intrinsically true, and thus without value.

In ICNIRP's own guidelines there are examples of warnings against findings from biological research as well as against the use of such more lax criteria needed to assess research on biological complex, dynamic, open systems. From a scientific perspective, these warnings are fully justified, but they may also be perceived as the results of a professional dogmatism, or from a strategic perspective as a tactic comment to discredit biological findings and to maintain the stakeholders' room for action:

> Ref. 244: Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, May 2020, Volume 118, Number 5, DOI: 10.1097/HP.0000000000001210, https://bit.ly/3maoRoo*:
>
> Appendix B, p. 36: “The experimental studies have the advantages of being able to control a large number of potential confounders and to manipulate radiofrequency EMF exposure. However, they are also limited in terms of making comparisons to realistic exposure environments, employing exposure durations sufficient to assess many disease processes, and, in the case of in vitro and animal research, relating the results to humans can also be difficult. Epidemiological research more closely relates to actual health within the community, but it is mostly observational and, thus, depending on the type of studies, various types of error and bias are of concern. These include confounding, selection bias, information bias, reverse causality, and exposure misclassification; in general, prospective cohort studies [studies of groups over a longer period of time, etc.] are least affected by bias but large sample sizes are needed for rare diseases.”

While all *biological effects* can be assumed to have a potential for harm and therefore give reason for further investigation and a line of caution, the ICNIRP creates a large room for manoeuvre by defining as not relevant for standard setting, any biological effect not found to cause damage that is manifest (“substantiated”) and scientifically determined according to the ICNIRP's method requirements above. Also, damage to life forms other than humans, which might be more fragile than humans, is excluded as the guidelines are clearly only relevant to damage on humans (italics applied for emphasis):

> Pages 36-37: “It is important to point out that the ICNIRP bases its guidelines on *scientifically proven* negative health effects. This makes *the difference between a biological and a health-related negative effect* an important distinction, where only negative health effects require restrictions to protect *people*.”

By having such a set of reasons to discard any damage found below thermally damaging exposure levels, ICNIRP discards or casts doubt even on the many epidemiological studies that demonstrate health damage from mobile communication base stations / cell phone masts, and the findings that these acute symptoms decrease systematically with distance from the masts (see Section 7). ICNIRP points at more or less insignificant or theoretical “weaknesses” as reasons for not attaching any importance to them (italics applied for emphasis):

> Page 37: “Epidemiological research has addressed possible long-term effects of exposure to radiofrequency EMF from fixed transmitters and from equipment worn close to the body, both in terms of symptoms and well-being, but with few exceptions these studies are *cross-sectional* studies with *self-reported* information on symptoms and exposure. *Selection bias, reporting bias, poor assessments of exposure strength and nocebo effects* are weaknesses of these studies. In studies of transmitters, *no consistent relationship* has been found between exposure and symptoms or well-being when objective exposure measurements have been made or when exposure information has been collected simultaneously. In studies of mobile phone use, a connection between symptoms and problematic behavior has been observed. However, these studies generally *cannot distinguish between the possible effects* of exposure to radio frequency EMF, and other effects of mobile phone use, such as insufficient sleep from using the mobile phone at night. On the whole, the e*pidemiological research cannot provide evidence for a causal relationship* between exposure to radiofrequency EMF and symptoms and well-being.”

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* Full link: https://www.icnirp.org/en/publications/article/rf-guidelines-2020.html

Such arguments show that the ICNIRP has requirements set in such a way that they cannot be met in practice, neither in laboratories, nor in real life or within realistic time frames.

6.11 A supply chain dominated by physics-based assessment criteria

Here we take a look at the processes leading to national exposure limits, and point at how ICNIRP's methods, networks and mindset dominate along these supply chains.

As mentioned above, ICNIRP uses physics-based criteria of the radiation hygiene tradition to recommend exposure maxima for humans based on thermal damage only, for radiofrequencies (and the induction of nerve signalling for low frequencies).

However, although ICNIRP states that it considers such thermally based exposure limits to be adequate (with substantial and explicit exemptions), ICNIRP explicitly prescribes that the users of the ICNIRP's guidelines should themselves assess whether the exposure limits are adequate, or should be set differently in order to cover new knowledge as to other effects. Such other effects might, evidently, be *biological, i.e. non-thermal effects or effects from other causations not covered by the ICNIRP guidelines, provided they are shown to be detrimental.*

> Ref. 245: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002

The responsibility of making such reviews of the scientific knowledge lay with the users of ICNIRP’s guidelines. To do this job, a multitude of review committees – permanent or ad hoc – are used at several steps along the supply chain from ICNIRP to the national radiation protection agencies. ICNIRP, as would be expected, recommends its own criteria for evaluation to be used, including adapting the exposure limits to vulnerable groups.

Through WHO's office *The International EMF Project*, which performs evaluations by committees staffed with ICNIRP members or others with conforming views, ICNIRP guidelines get the approval of WHO, although WHO formally does not recommend one guideline or another.

Through WHO, ICNIRP markets its assessment criteria and works actively to disseminate them in countries with no or stricter exposure limits, such as the states of Eastern Europe and of the former Soviet Union. The tiny WHO office publishes information material and guidelines which summarise ICNIRP’s views and prescribe how the next links in the chain should themselves assess the status of knowledge – by using criteria that aims to keep limits scientifically based, as opposed to the resulting emotional, unfounded political pressure. See for example:

> Ref. 246: Framework for developing health-based electromagnetic field standards, World Health Organization, 2006, ISBN 92 4 159433 0, https://www.who.int/publications/i/item/9241594330

The delivery chain from ICNIRP to the national radiation protection agencies is illustrated in Figure 69.

The presentation of the supply chain in Figure 69 places emphasis on showing that this delivery process also has a strong educational and institutionalising function by promoting the traditional mindset of the *thermal paradigm*, which functions as a defence. In this way, by high threshold values, the greatest possible support is given to those wishing maximal elbow room to exploit non-ionizing electromagnetic radiation. Several researchers emphasise this, e.g.

Ref. 247: Butler, Tom: Wireless Technologies and the Risk of Adverse Health Effects in Society: A Retrospective Ethical Risk Analysis of Health and Safety Guidelines, Working Paper, Univ. of Cork, 2021, PDF-paper, https://bit.ly/3ERGKPz*

Using the criteria recommended by ICNIRP and the WHO *International EMF Project* office, and *not* using to the Hill criteria (Ref. 243) or similar, these committees assessing the research all conclude that biological harm has "not been demonstrated with sufficient certainty".

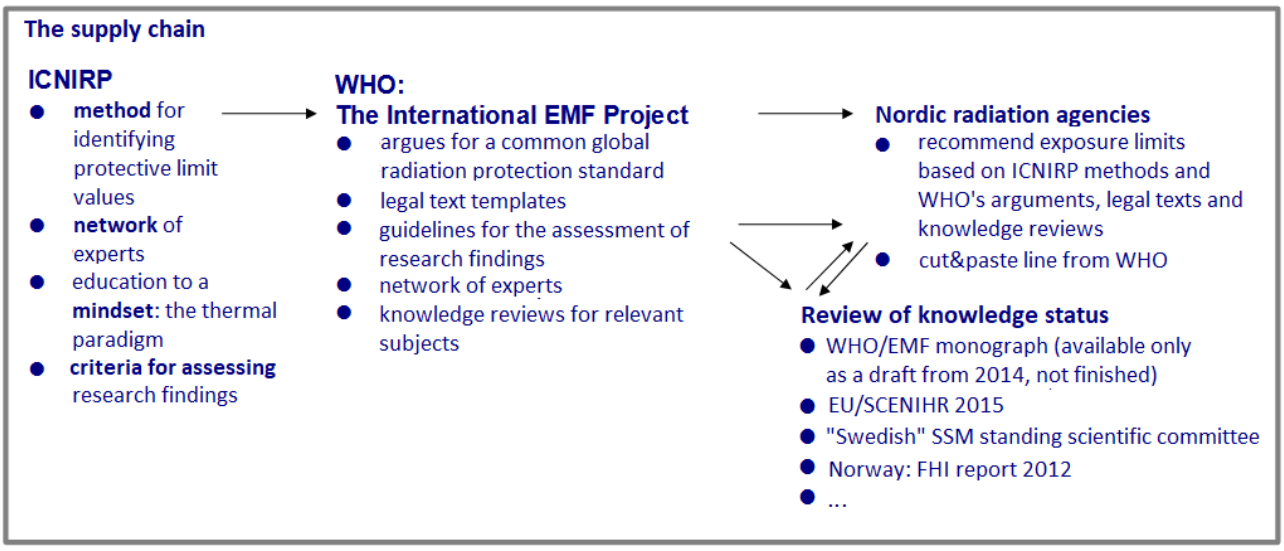

Figure 69: The supply chain for exposure limits, with examples (From E. Flydal, various lectures)

Hence, the supply chain functions as a bulwark: Under the cover of high research standards, methodological rules and strict requirements for accepting harmful effects, these entities defend by their way of work a business liberalism policy: Business liberalism – that no hindrances should be set up unless there is a scientifically proven need – is embedded in the assessment criteria. While the committees assess and discard old research findings, technological development continues and ever-new technologies with biologically more or less unknown and unexplored effects – or even well evidenced detrimental effects – are deployed. Seen as part of a power struggle, the assessment criteria are tools for obstruction. An overview of obstruction effects from a set of assessment criteria is shown in Figure 70.

Figure 70 shows that the assessment criteria are very efficient tools for rejecting any empirically based research results identifying harmful effects below thermal limits. The figure is taken from, and the theme is elaborated on in

Ref. 248: Ref. 240: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, 590 pages (Norwegian)† pp. 398 – 401.

* Full link: https://einarflydal.com/wp-content/uploads/2021/02/Butler-Tom-Wireless-Technologies-Ethical-Risk-Analysis-Working-Paper-Univ.-Cork-2021.pdf (Several newer papers by Butler also make this point.)

† Flydal, Einar & Nordhagen, Else (ed.): 5G og vår trådløse virkelighet – høyt spill med helse og miljø, Z-forlag, 2019, https://bit.ly/3IuR5Ub, or https://einarflydal.com/?smd_process_download=1&download_id=76665

Assessment Criteria[353]	Obstructive Effects[354]
One should avoid drawing conclusions based on exposure values higher than in the real world.	Ensures that investigations will take a very long time. Higher exposure values are standard to save time.[355]
Weak epidemiological connections should be rejected in favour of well-understood causal mechanisms.	Gives room to discard statistical findings in favour of oversimplified physical explanatory models dealing with selected parts of the real world.
Supportive peer reviews are not sufficient for a research finding to be taken into account.	Moves the assessment into the hands of the committee's own discretion.
Strong connection between dose and response is important.	Runs contrary to discoveries in biology in general: Biological systems are often self-regulating. Responses are therefore often inconsistent, weak, and show complex, non-monotonic dose-response relationships with the dose.
The study must be able to identify actual risk, without bias or confounding factors.	Requires research on complex biological systems, while at the same time requiring a high degree of control over the factors. Discards lots of detailed and solid findings from research on closer endpoints. When dealing with complex systems, estimations of actual risk for will always be open to dispute.
It is important that a dose-response relationship can be demonstrated between the EMF exposure and a health-related adverse effect.	Very many studies on EMFs and complex biological systems will fail against this requirement: The relations between EMFs and health effects are very often non-linear, non-uniform and non-monotonic. And they may interact with external factors.
There must be evidence from laboratory animals, not just from *in vitro* cell studies.	Requires studies to address biological complex systems in order to be accepted. Hence, the results might often be not consistent, but weak and without clearly identifiable causal lines.

353 Following Mercer 2016
354 Our assessments based on Mercer 2016 and others.
355 For example, it follows from such a claim that a population survey on health effects from mobile phone use may easily take around 60 years (real radiation levels, 20-year lead time, two replications). Still it will not be able to fulfil the requirement of clearly demonstrable causal chains, as it, according to others requirements, must study whole, complex biological systems, which dilutes the strong and clear relations demanded. No mobile system, and hardly any researchers, have such a long active time.

Figure 70: Assessment criteria for research studies promoted by The International EMF Project and ICNIRP (translated from Flydal and Nordhagen 2019)

An (incomplete) overview of (by March 2023) 92 literature reviews based on assessment criteria such as recommended by ICNIRP and the WHO The International EMF Project, is found here:

> Ref. 249: Expert Reviews – Statements from Governments and Expert Panels Concerning Health Effects and Safe Exposure Levels of Radiofrequency Energy (2010-2020)
> https://www.ices-emfsafety.org/expert-reviews/

The list is published by ICES (the International Committee on Electromagnetic Safety). ICES is a committee with an ICNIRP-like purpose: "to develop standards for the safe use of electromagnetic

energy in the range 0 Hz to 300 GHz", and "operates under the rules and supervision of the management of the IEEE Standardization Division Board"*.

The 92 reviews are based – more or less formalised – on evaluation criteria similar to those mentioned above, common with ICNIRP, and as shown in Figure 70. Hence, they do of course draw the same conclusion – formulated in slightly different ways – that "biological harmful effects have not been proven", or not proven "with adequate certainty".

Journalists of the *Investigate Europe* group, showed in a series of articles on 5G, how small and tightly knit the set of insiders is "who reject alarming research – and who set safety limits." This small and tight network, from which states get advice, was essential in paving the way for 5G†. Key people in the committees doing reviews are ICNIRP members and people closely similar in their views. For a dynamic view on the core of this network, see

> Ref. 250: "How much is safe?", Investigate Europe, 4 January 2019, https://bit.ly/3ZiqbEC‡

Within the ICNIRP guidelines of March 2020, the limits for exposure have bee raised significantly compared to the guidelines issued in 1998. In a survey of the research literature on which the new guidelines are based, it is shown that virtually *all* the literature to which these new and more lax guidelines refer, have ICNIRP members as co-authors. The very few – three – reviews cited in the guidelines which find damage below thermal levels, are rejected, falsely based on criteria similar to the ones mentioned above.

> Ref. 251: Nordhagen EK, Flydal E. Self-referencing authorships behind the ICNIRP 2020 radiation protection guidelines. Rev Environ Health. 2022 Jun 27. doi:10.1515/reveh-2022-0037. Epub ahead of print. PMID: 35751553, https://bit.ly/3YdGnFH§

Hence, we see that the ICNIRP's guidelines are underpinned by evaluation criteria stemming from the tradition of radiation hygiene and physics, and are solidified through a delivery chain dominated by a small network of persons who discard the findings of damage done in biological research.

6.12 Industrial and political affiliations determine scientific findings

Here, it is shown that scientific findings co-vary with the source for funding of the study.

Figure 71 shows quantities of published papers by country registered in the ORSAA database of research literature on non-ionizing radiation and health and environmental effects (http://www.orsaa.org). The table shows that those countries with the most published articles not finding *biological effects* are also the countries that are the most Western and US-oriented – with the exception of the USA itself, which has the highest number of articles both by those who find and those who do not find *biological effects*.

* Cited from https://www.ices-emfsafety.org/

† https://www.investigate-europe.eu/en/page/1/?s=ICNIRP

‡ Full link: https://www.investigate-europe.eu/en/2019/how-much-is-safe/

§ Full link: https://www.degruyter.com/document/doi/10.1515/reveh-2022-0037/html

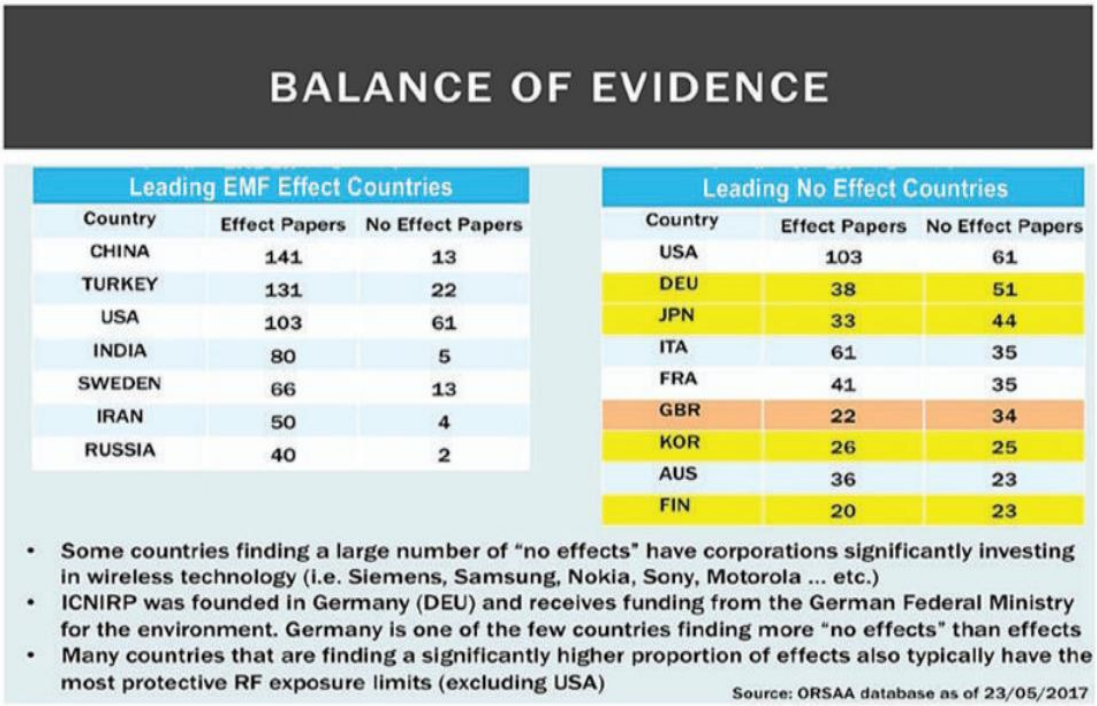

Figure 71: Countries grouped by findings of EMF effects corresponds to political affiliations and industrial interests (ORSAA Leach & Weller 2017)

The countries with the lowest number of papers that find *biological effects* are also the countries where the exposure limits are set equal to ICNIRP's guideline values to protect against heating and defend this as sufficient. This suggests that the exposure limits result from economic and political loyalties/alliances, not the other way around.

> Ref. 252: Victor Leach and Steven Weller. Radio Frequency Exposure Risk Assessment And Communication: Critique Of ARPANSA TR-164 Report. Do We Have A Problem?, ARPS42 Conference Paper, *Radiation Protection in Australasia* (2017) Vol. 34, No. 2, s. 17:
>
> "Countries that have significant financial interests in the communications industry also produce the most studies that show "No effect", compared to countries that have a modest interest in communications technology."

These findings from Figure 71 fit well with how research findings are distributed when compared with funding: See Figure 72. The graph is based on data extracted from the ORSAA database, as of October 2020. (Data kindly received on request from Steven Weller, ORSAA.)

Figure 72 shows that research financed only by independent funds (the two columns to the left) finds biological effects, i.e. potentials for damage, far more often than research financed from radiation protection authorities "adhering to ICNIRP" and the USA (column 3 from the left). And even less often, effects are found in research funded by communications authorities (right column).

Hence, purely in terms of numbers, it seems obvious that the communication sector's interests and the country's political affiliation – not the medical or biological interests – explain whether research finds detrimental effects or not. The sector's interests and politic alliances determine the research findings – not the other way around: Finding effects de-legitimises the thermal paradigm. If the research does not find any damage, exposure limits based on the *thermal paradigm* are legitimised.

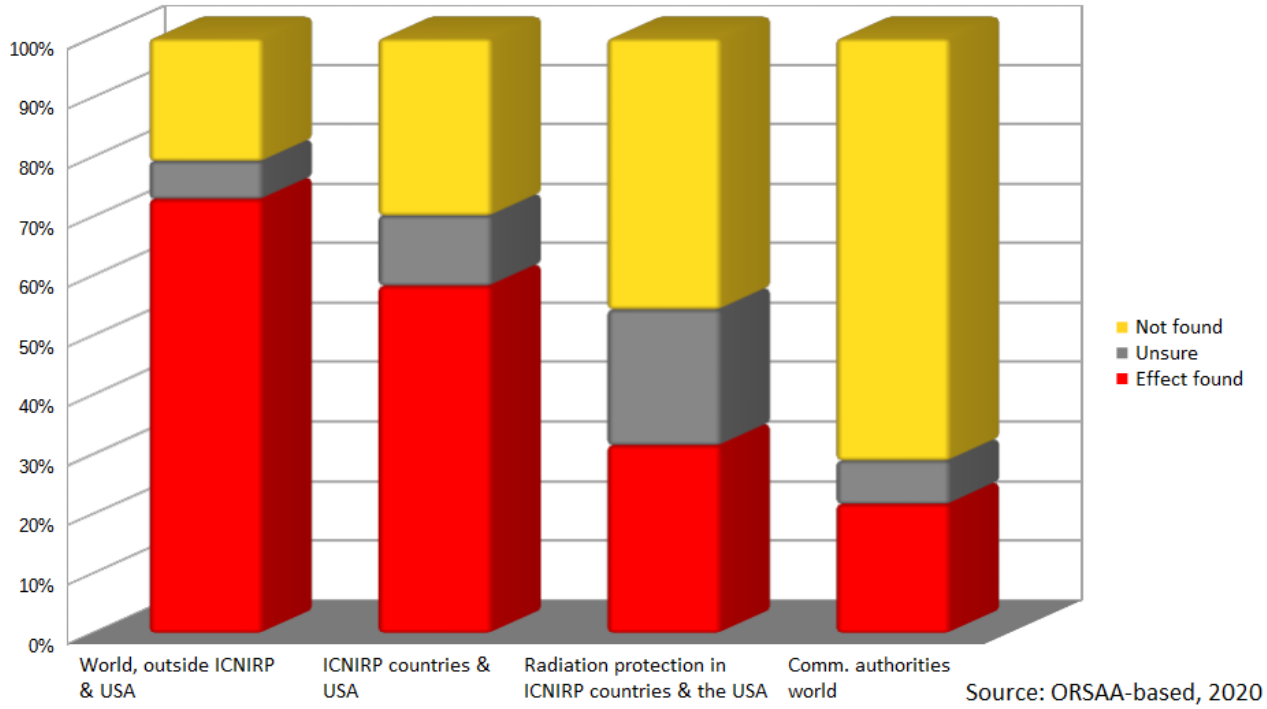

Figure 72: The columns show percentage of papers finding effects from EMF's by funding. The more the funding stems from the ICNIRP or USA and followers, or from communications authorities, the fewer findings of effects are made. (Data from ORSAA Oct. 2020)

6.13 The research base does not explain the gap of exposure limits

Both in the USA, Central Europe and in Eastern Europe there has long been extensive research demonstrating *biological effects* from sub-thermal exposures.

Biological effects from sub-thermal exposures have been extensively researched in Central Europe since late 18th century. (See Ref. 67, Part 1.)

Overviews of results from more recent research in bioelectricity and health risks are given in

> Ref. 252b: Marino, Andrew A. (ed.): Modern bioelectricity, Marcel Dekker Inc., 1988

Russia, India, China, Italy, Israel and several other countries and regions find the ICNIRP's and WHO's recommendations too lax. Hence, the authorities of these countries consider that even weak radiation can cause a number of different damages and set exposure restrictions to protect against these. As shown in Figure 73, they have exposure limits one tenth or less of those we have in Norway.

The findings underpinning these stricter exposure limits have been known both in these countries and in the West for a long time. Here are just two major reviews: an extensive Russian research review from the Soviet Union translated into English, with 678 references – among others Russian, German, Polish as well as Western research, published in New York in 1970; and an extensive bibliography from the US Navy from the following year:

> Ref. 253: Presman, A. S., 1970. "Electromagnetic Fields and Life", English edition: Springer science+business media LLC, New York, 1970, ISBN 978-1-4757-0637-6.

Ref. 254: Naval Medical Research Institute, NMRI (Zorach, R., & Glaser, 1971). Bibliography of Reported Biological Phenomena (‘effects’) and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, 1971/72, https://www.magdahavas.com/wp-content/uploads/2010/06/Navy_Radiowave_Brief.pdf

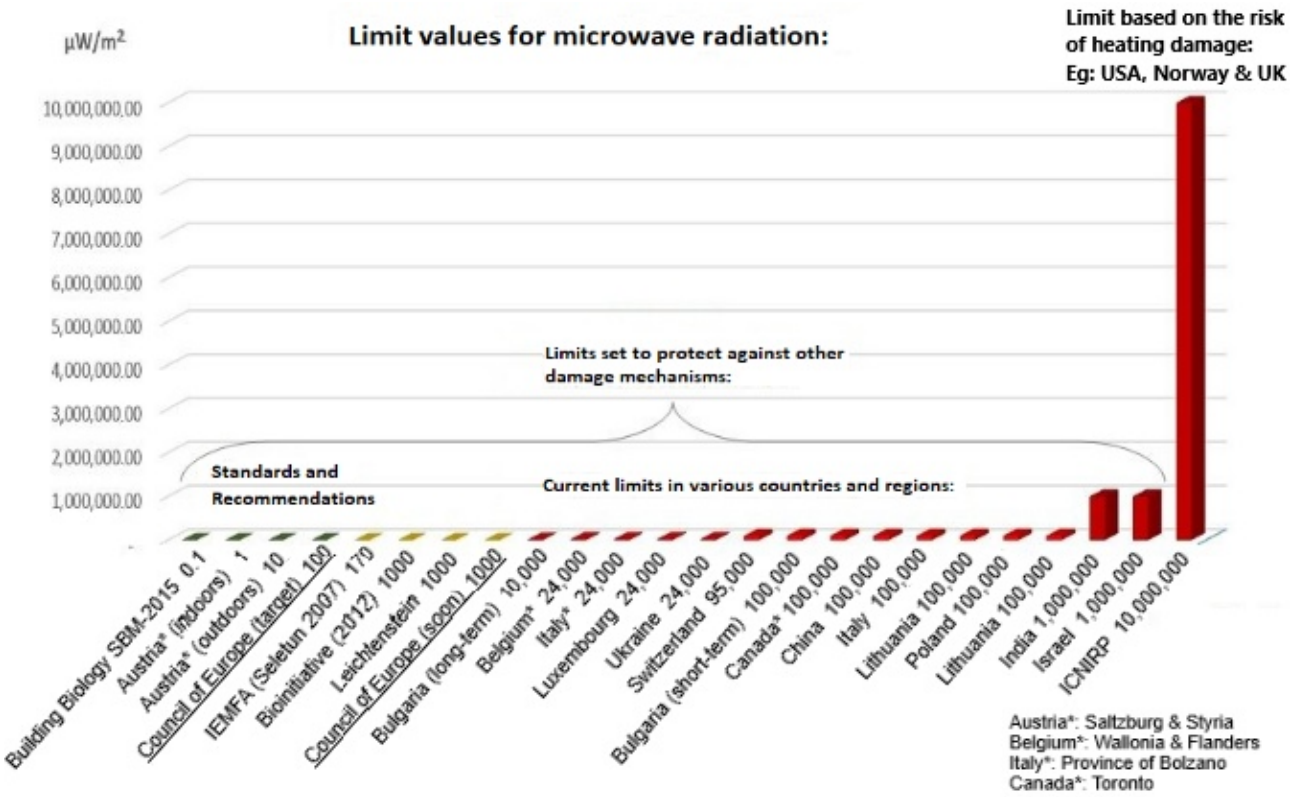

Figure 73: Exposure limits (µW/m²) for “non-ionizing” radiation (from Jamieson 2014)

6.14 ICNIRP and adherents shape exposure policy while opposing the WHO through the WHO itself

Here we show that ICNIRP advocates a view of thermal damage as the only relevant causation which contradicts IARC's (the WHO's cancer organisation) view, and does so even through WHO itself.

There is in-house disagreement within the WHO as to *biological effects* from electromagnetic radiation.

We have seen that in scientific research this disagreement can be traced back to a range of issues, like stakeholders funding the research, as well as to opposing attitudes within different scientific traditions like radiation physics versus biology and medicine, which parameters to measure, how to interpret inconsistent outcomes, as well as the appropriate strictness of proofs to apply while assessing causation.

The choice between high stringency in scientific proofs vs. risking exposure limits to be set unnecessary strict so that economic development and welfare is hampered, is not of scientific nature. It is *per se* political. Recommending exposure limits therefore becomes what is also in ICNIRP terminology considered *political* – not scientific – action.

Parts of this action are carried out by the earlier mentioned (see Section 2.3) tiny International EMF Project, the WHO advocate ICNIRP's guidelines and defend the "thermal only" view on health effects in line with ICNIRP guidelines. This tiny office for the promotion of a common global standard for radiation protection seems to have only two employees, a director and a secretary. This tiny staff is largely supplemented with ICNIRP people when extra work has to be done. Created by the founder of ICNIRP, acting as a consultant for WHO, this office not surprisingly conveys ICNIRP's guidelines and main perspectives in the name of WHO (e.g., see Ref. 246).

This channelling through WHO caters for a two step dilution of responsibility: As seen previously, ICNIRP clearly explains – in "fine print", i.e. in the quite complicated language of formal standards – its thermally based methodology. It also takes no responsibility for the outcomes of adopting its guidelines and suggested exposure maxima, it recommends users to make their own independent assessment of the state of knowledge and need for setting the exposure limits differently. ICNIRP's reservations are substantial, but carefully crafted as one will see in the ICNIRP's method and evaluation criteria:

> Ref. 255: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002

With WHO in the role of guarantor, responsibility is lifted even further away from ICNIRP and over to WHO, which also argues for itself being without any responsibility in the matter.

Furthermore, we showed in

> Ref. 255b: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3*, Part 2, Section 6.1

that ICNIRP members populate key positions in the central committees reviewing science to assess whether using ICNIRP's thermally based recommendations are adequate to set exposure limits, or if more restrictive limits should be set.

In this way, the ICNIRP ensures that its assessment criteria, as well as lax exposure limits, are adopted and supported in so many countries, among them Norway.

And from

> Ref. 255c: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, https://bit.ly/41HYFS8, 590 pages (Norwegian)†
> Fig. 37, p. 410

we here reproduce Figure 37 (page 410) translated: It demonstrates how ICNIRP members and experts are as well business affiliated (mostly through financed research), populate and overlap in committees which should make their own independent, unbiased scientific reviews to check whether ICNIRP's recommendations are adequate for protection of the general population:

* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

† Flydal, Einar & Nordhagen, Else (ed.): 5G og var tradlose virkelighet – hoyt spill med helse og miljo, Z-forlag, 2019, https://einarflydal.com/?smd_process_download=1&download_id=76665

		ICNIRP members and consultant experts	IEEE	WHO Core Group & Drafting Team	COST (org. for tech.dev.)	business affiliation	**EU SCENIHR** member	SSM scientific comm., Sweden	FHI report 2012, Norway
van Rongen	Eric	**m**	x	cg	x		x	x	
Scarfi	Maria Rosaria			dt	x	x	x	x	
Juutilainen	Jukka			dt		x	x	x	
Danker-Hopfe	Heidi	**c**					x	x	
Sienkiewicz	Zenon	**m**		cg		x	x		
Auvinen	Anssi	**c**		dt		x	x		
Mattsson	Mats-Olof	**m**				x	x		
Mild	Kjell Hansson	**c**			x	x	x		
Norppa	Hannu	**c**					x		
Rubin	James	**c**				x	x		
Samaras	Theodoros	**c**	x		x	x	x		
Schüz	Joachim				x	x	x		
Simko	Myrtill					x	x		
Zeni	Olga					x	x		
Feychting	Maria	**m**		cg		x		x	x
Klaeboe	Lars			dt		x		x	x
Röösli	Martin	**m**		cg	x	x		x	
Dasenbrock	Clemens			dt				x	
van Deventer	Emelie	**c**	x			x		x	
Huss	Anke	**c**				x		x	
Oftedal	Gunnhild	**m**		cg	x	x			x

m: ICNIRP council member
c: ICNIRP consultant expert
x: Member of other organisation

dt: WHO Drafting team member
cg: WHO Core Group member

Figure 73b: Examples of ICNIRP members and experts populating the literature review committees (from Flydal & Nordhagen 2019)

Where ICNIRP members participate in the review committees to assess the state of knowledge, the ICNIRP's mindset always dominates, and the review conclusions are, as we have seen in previous sections, always conforming to ICNIRP’s views that no health issues below thermal thresholds have been sufficiently well proven to form the basis for more restrictive exposure limits.

This situation regularly triggers protests and complaints from scientists within biology and medicine addressed to the WHO top management as well as to governments of countries where national committees do their reviews in line with ICNIRP’s guidelines.

Here follows an example regarding Switzerland's national committee BERENIS, and the committee's leader, an ICNIRP member, here accused for fraud:

Ref. 256: Letter to Simonetta Sommaruga, President of the Swiss Federation, 7th January 2020 from Franz Adlkofer, et al, https://bit.ly/3EXVVXi*

Last time such a review was carried out in Norway was in 2012.† The ICNIRP's evaluation criteria were used and the relevant parts of the evaluation were headed by ICNIRP members of the review committee. The conclusions were, as the reader might expect: “No damage definitely detected” and “more research is needed”.

Ref. 257: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012‡

This literature review rejects all literature reviews not carried out by ICNIRP or according to ICNIRP’s demand for dosimetric identification of energy intensity thresholds. It also rejects all findings of sub-thermal effects as “not sufficiently reliably demonstrated”.

The report, which in its foreword states that its views and conclusions are the ones of the committee, not necessarily that of the Institute of Public Health (FHI), was nonetheless published in the institute’s series of *FHI-reports*, an act which legitimised it as a public policy document. Thereby, the FHI-report solidified the Norwegian thermally based radiation protection policy, a policy which seems most convenient for political and commercial alliances, but fails to take into account well evidenced *biological effects*. Hence, the committee report does not take a precautionary approach, as it, according to the Norwegian constitution, should have done from the moment significant *biological effects* seem plausible outcomes.

Although following the ICNIRP/WHO recommendations, the committee report ends up being at odds not only with the lion’s share of scientific results, but also with the IARC classification in 2011 of electromagnetic radiation as “class 2B – possibly carcinogenic to humans“.

Ref. 258: Robert Baan, Yann Grosse, Béatrice Lauby-Secretan, Fatiha El Ghissassi, Véronique Bouvard, Lamia Benbrahim-Tallaa, Neela Guha, Farhad Islami, Laurent Galichet, Kurt Straif, on behalf of the WHO International Agency for Research on Cancer Monograph Working Group: Carcinogenicity of radiofrequency electromagnetic fields, The Lancet Oncology, Early Online Publication, 22 June 2011, doi:10.1016/S1470-2045(11)70147-4

Ref. 259: IARC Classifies Radiofrequency Electromagnetic Fields As Possibly Carcinogenic To Humans, WHO, Press release N° 208, 31 May 2011

IARC has set the work plan to re-evaluate the hazard class from 2B to 1A or B, since there are new research findings (“New bioassay and mechanistic evidence”) that may justify a heightened hazard class.

Ref. 260: IARC 2019. “Advisory Group recommendations on priorities for the IARC Monographs”, The Lancet Oncology, Published: April 17, 2019, https://doi.org/10.1016/S1470-2045(19)30246-3

* Full link: https://einarflydal.com/wp-content/uploads/2020/01/Whistleblow-Martin-Röösli_January-2020.pdf

† Added spring 2023: A Norwegian smaller review of reviews is carried out, based on basically the same methodology, and planned to conclude towards the end of 2023.

‡ Original title: “Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis”, (Norwegian with English summary). Full link: https://bit.ly/3Cu9IDW, or https://www.fhi.no/globalassets/2012-3_mobilstraling

However, shortly after the publishing of these recommendations, staff members of IARC were replaced with persons less sympathetic to such a stricter classification. Hence, the result of the revision remains to be seen.

During the same meeting the FHI-report was handed over to the Norwegian minister of health, the minister also received from an observing member of the review process, a "counter-report" with significant criticism of the FHI-report itself. Although promises were given that it would be read, that report was never countered, commented or refuted by Norwegian authorities, but simply drowned in silence:

> Ref. 261: Glomsrød, Solveig & Solheim, Ida: Health effects of electromagnetic fields, 2012, https://bit.ly/3ZqqGMR*

Important policy questions arise from this situation. They include: *Should proven biological reactions satisfying biologically based assessment criteria be considered "too uncertain" to be taken into account in Norwegian radiation protection policy?*

The question is not on the agenda in Norwegian political circles, not even discussed. *In practice, the political choices are left to the radiation protection administration and the reviews it asks for when felt necessary.*

6.15 More guidelines for biologically based exposure limits

Researchers and professionals in biology and medicine have set forward various proposals for guidelines as to exposure limits for radiofrequency (RF) radiation, based on *biological effects*. Here are some very scarce extracts from such guidelines, with reference to AMS-meters.

The limits are stated as recommended limits for radiated effect, i.e. energy level in the exposure, but some of the proposals, the **Building Biology guidelines** and the **EUROPAEM guidelines**, differentiate between different pulsation types.

We first summarise them here in a simplified table, before we nuance and provide references:

Guideline:	**Recommended max. exposure, µW/m²:**
ICNIRP guidelines, 1998	2,220,000 – 4,350,000
The Seletun Declaration 2009	<1700
The Building Biology guidelines	10-1000
EUROPAEM 2016	1 during night (0.1 for the particularly sensitive)
BioInitiative Group 2002	health effects begin around 3 – 6
Limit practised by the telco Telenor (now abandoned)	100,000 per source

As to the frequencies of carrier waves used by AMS meters in Norway (444 – 870 MHz), **ICNIRP's guidelines from 1998** recommend for the relevant frequencies the following maximum exposure levels: **2,220,000 – 4,350,000 µW/m²**. These are thus the range of recommended exposure limits in Norway. A comparison with EUROPAEM recommendations is found in

> Ref. 262: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, 2018, https://bit.ly/3BI97h3†, Part 2, Figure 17.

* (Norwegian.) Original title: "Helsevirkninger av elektromagnetiske felt", full link: https://emf-consult.com/rapport-helsevirkninger-av-elektromagnetiske-felt/

† Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

The **Seletun Declaration 2009** was published by an international expert panel which proposed exposure limits based on the intensities at which *biological effects* have been demonstrated and explained as proven health effects:

> Ref. 263: Adamantia Fragopoulou, Yuri Grigoriev, Olle Johansson, Lukas H Margaritis, Lloyd Morgan, Elihu Richter, Cindy Sage: Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales, Rev Environ Health. Oct-Dec 2010;25(4):307-17. https://pubmed.ncbi.nlm.nih.gov/21268443/

The Seletun declaration proposed exposure limits, safety margin not included, which is “approx. 50,000 – 60,000 times lower than current ICNIRP/IEEE guidelines, but may turn out to be too high.”:

- For radio frequency (RF) fields: **<1700 µW/m²**

The Seletun panel's comment was as follows:

- The panel recommends a provisional far-field limit for the whole body of 1.7 mW/m² (= 1,700 µW/m²)
- ... it may also be argued that it is reasonable to reduce this limit by a further tenfold as a precaution. If a ten-fold reduction is used, the recommended limit will be 0.17 mW/m² (= 170 µW/m²)

Building Biologists 2015: Building Biology is an interdisciplinary formalised education institute that sprung from the academic part of the environmental movement in Germany in the 1960s. Today, it offers additional education for environmentally conscious structural engineers, architects and structural technical consultants.

As to exposure to radio frequency radiation in living spaces/bedrooms, Building Biologists indicate “levels of concern” (German: “Auffälligkeit”), with some additional, more detailed information:

> Ref. 264: Building biological guidelines for sleeping areas, supplement to the standard, Ergänzung zum Standard der baubiologischen Messtechnik SBM-2015, BAUBIOLOGIE MAES / Institut für Baubiologie + Nachhaltigkeit IBN, https://bit.ly/3Yru3BX*

Unit of measurement	No reason to worry	Slight cause for concern	Serious cause for concern	Extreme cause for concern
µW/m²	<0.1	0.1-10	10-1000	>1000

EUROPAEM 2016: EUROPAEM, The guidelines from the European Academy for Environmental Medicine, were developed on the basis of guidelines developed by a committee under the Austrian Medical Association. To date, this standard is the most comprehensive and detailed, based on biological research findings and clinical experience.

> Ref. 265: EUROPAEM Guidelines 2016: Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshammer, Piero Lercher, Kurt Müller, Gerd Oberfeld, Peter Ohnsorge, Peter Pelzmann, Claus Scheingraber and Roby Thill: EUROPAEM EMF guidelines 2016 for the prevention, diagnosis and treatment of EMF-related health problems and diseases (original reference: Rev Environ Health. 2016 Sep 1;31(3):363-97. doi: 10.1515/reveh-2016-0011)

* (German), original title: “Baubiologische Richtwerte für Schlafbereiche”, full link: https://www.baubiologie.de/downloads/richtwerte-schlafbereiche-15.pdf

For exposure to radio frequency radiation, the EUROPAEM guidelines state precautionary-based guideline values which, for microwaves, are suggested depending on the signalling system and its modulation, i.e. how “pulsation is built” in the respective communication system. (See notes below the EUROPAEM guidelines' Table 3, reproduced above as Figure 66.)

For the frequencies relevant for AMS meters (in Norway), the following values are specified:

Unit of measurement	Daytime	Night	Particularly electro-sensitive
µW/m²	100 – 10	10 – 1	1 – 0.1

The BioInitiative Working Group, 2002, 2012, 2017: The BioInitiative 2012 report was prepared by an expert group of 29 authors from ten countries – The Bioinitiative Working Group. The report is a review of more than 1,800 research studies.

> Ref. 266: Bioinitiative Working Group, David Carpenter and Cindy Sage (eds). 2012. *Bioinitiative 2012: A rationale for biologically-based exposure standards for electromagnetic radiation.* http://www.bioinitiative.org/

The BioInitiative Working Group does not give a specific proposal as to exposure limits, but indicates an *effect level* for radio frequency radiation, i.e. the level of energy intensity exposure at which *biological effects* begin to show up. This level is indicated by the BioInitiative Working Group as a “reasonable precaution-based measure limit for sustained exposure to pulsed radiofrequency radiation”:

> Ref. 267: BioInitiative 2012 – Conclusions Table 1-1, Defining A New ‘Effect Level’ For RFR, https://bioinitiative.org/conclusions/

The precautionary limit for sustained exposure to pulsed radio frequency radiation is set at 0.3 to 0.6 nanowatts/cm^2, i.e. **3 – 6 µW/m^2**.

“**Limit practised by Telenor”**: Telenor Norge, through area coverage manager Bjørn Amundsen, declared around 2008 a self-imposed “exposure limit to be practised”, which meant that exposures from Telenor's base stations should not exceed 1/100 of the ICNIRP exposure limits, i.e. not more than 100,000 µW/m^2. Responses to emails from the authors to Telenor's area coverage manager indicate that this limit is no longer considered binding Telenor.

> Ref. 268: email exchanges between E Flydal, Bjørn Amundsen (Telenor), Roger Lien (Telenor), and Sissel Halmøy, 4. - 6. December 2020

6.16 Exposure limits underpinned with sloppiness and irrelevant research

Here we show how the thermal exposure limits are defended in illegitimate ways with studies not having found any correlations, or by refuting all research that did.

Refuting the existence of damage from sub- or non-thermal exposure is in the literature reviews justified by claiming that findings of damage “are not sufficiently certain”, and by referring to research that does *not* find any health effects.

However, the “non-findings” between a cause and an effect in some studies can not justifiably be used to refute such findings made in other studies: Considered as evidence, non-findings are of very little weight. Instead, refutations must be done by demonstrating errors in the respective study.

As we have seen earlier, if evaluation criteria are set extremely strict, all empirical studies can be dismissed and so are in the reviews using the criteria recommended by ICNIRP/WHO: Such criteria lead to a refusal to accept findings made at exposure values below the thermal limit. In the height, it is stated that the findings “are not sufficiently well proven, and more research is necessary“.

The Norwegian literature review of 2012 (FHI 2012:3), which forms a significant part of the founding of Norwegian health policy as to non-ionizing radiation protection, provides a typical example:

In no area whatsoever does this selection report find sufficiently well-proven findings below the thermally based exposure limits. Even where such effects are indisputably found, the committee suggests that they may be due to heating and “need not be harmful”.

Below is a selection of excerpts from the report's conclusions, area by area (pp. 17 et seq.). In all these areas, biological research demonstrates findings, but by the choice of overly stringent evaluation criteria for accepting evidence and a biased methodology one might justify the argument that none of these findings should be accepted as sufficiently certain. This way, a basis for the thermally based exposure limits is constructed on non-findings, and on discarding all positive findings as not sufficiently certain (our translations):

> Ref. 269: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012*
>
> **ICNIRP's findings, p. 17:**
> “For exposure at levels below ICNIRP's reference values, ICNIRP has found no documented harmful effects, despite the existence of extensive research. Neither has any mechanism for how such effects could possibly occur been identified.”
>
> **Health effects in general, p. 18:**
> “In some studies, observations suggest that exposure to weak RF fields might have measurable biological effects. In several of the studies, however, it is difficult to rule out that the exposure ... may have led to local heating. [This] ... does not mean that health damage has occurred.”
>
> **Cancer, p. 19:**
> “Overall, these studies [which purportedly do not find sufficiently certain connections] provide further evidence that exposure to weak RF fields does not lead to cancer.”
>
> **Propagation, p. 20:**
> “Overall, there is little evidence that exposure to weak RF fields negatively affects fertility. Neither do the few studies available provide evidence that exposure to weak RF fields during pregnancy has adverse effects on the fetus.”
>
> **Heart/vessels, p. 20:**
> “Overall, the studies of good quality do not provide evidence that weak RF fields have harmful effects on the cardiovascular system.”
>
> **The immune system, p. 20:**
> “Older studies, as well as recent studies of good quality, do not provide clear evidence of negative effects of exposure to weak RF fields on the immune system.”

* Original title: “Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis”, (Norwegian with English summary). Full link: https://bit.ly/3Cu9IDW, or https://www.fhi.no/globalassets/2012-3_mobilstraling

Hormonal effects, p. 20:
"Previous and recent studies do not provide evidence that exposure to weak RF fields negatively affects the hormonal system in humans."

The nervous system, pp. 20-21:
"The responses may in many cases represent a [harmless] bodily adaptation to an external influence."

"Animal experiments do not provide reasons for assuming that exposure to weak RF fields leads to biological effects in the nervous system. Many [human studies] ... provide some evidence that exposure to RF from GSM phones may lead to small and transient changes [in brain activity, but] not accompanied by symptoms or poor sleep quality. 3G (UMTS) phones do not seem to have this effect, but there are few studies with this type of phone. [R]esults [effects on blood flow and metabolism in the brain] are partly contradictory."

"Overall, there is no evidence that exposure to weak RF fields affects performance or behaviour [in adults and young people]."

"No evidence that weak RF fields cause symptoms such as headache, tiredness or concentration problems, neither with short-term nor long-term exposure. ... no evidence of damage to sight, hearing or balance organs. .... [N]o evidence of [severe effects on the central nervous system that could] cause serious disorders to occur."

"The gene expression in cells is normally constantly changing [especially with] influence. Changes in gene expression have been observed ... but ... not coincidental results ... with regard to which ... genes show altered regulation. ... Little evidence of ... unequivocal changes in gene expression that might be linked to harmful effects in humans."

Health problems attributed to EMF (Electro-hypersensitivity), p. 21:
"The expert group concludes that scientific studies indicate that EMF is not the cause or contributing cause of the condition of health problems attributed to EMF (electro-hypersensitivity)."

Biologically oriented researchers criticise both the assessment criteria and the requirements for unequivocal evidence used in such evaluations, as they result in good studies being discarded:

Ref. 270: Sage, Cindy, Carpenter, David, and Hardell, Lennart, 2015. "Comment on SCENIHR: 'Opinion on Potential Health Effects of Exposure to Electromagnetic Fields', Bioelectromagnetics 36:480-484, (2015)", Bioelectromagnetics 37: 190-192 (2016):*

"SCENIHR has used the wrong test by requiring absolute proof and mechanistic evidence of potential EMF effects. The embedded up-shifting language instead requires demonstration of "conclusive or unequivocal evidence" [BioInitiative Working Group, 2014, 2015; SCENIHR, 2015a]. As a result, even where the report documents good quality, peer-reviewed study evidence for potential risk, these data are simply dismissed. Short of a finding of causal evidence, it appears the SCENIHR review process will not label any evidence as having potential health effects."

Other similar accusations concern downplaying, outright omissions, misinterpretations and sloppiness, and comparing incomparable studies and pitting them against each other. Similar defective assessments have been demonstrated in several such literature reviews, including reviews attributed high importance for radiation protection policy, in for example; Norway, Great Britain

* Also included in (Norwegian) in Flydal and Nordhagen (ed.) 2019, pages 175-182.

and the USA as well as by WHO and ICNIRP. Such assessments are mentioned in a number of places in the following three sources:

Glomsrød and Solheim (2012), dealing with the FHI report 2012:3, mentioned above; Wright (2017), dealing with ICNIRP, the WHO, the telecoms industry and British radiation protection; Starkey (2016), addressing AGNIR, the (later decommissioned) UK standing committee for the investigation of health aspects of non-ionizing radiation:

> Ref. 271: Ref. 261: Glomsrød, Solveig & Solheim, Ida: Health effects of electromagnetic fields, 2012, https://bit.ly/3ZqqGMR*
>
> Ref. 272: Wright, Nicola: "Downplaying Radiation Risk", Chapter 23 in Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y.,2017
>
> Ref. 273: Starkey, Sarah J.: Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionizing Radiation, Rev Environ Health 2016; 31(4): 493–503, DOI 10.1515/reveh-2016-0060

From the perspective of *stakeholder strategies*, conclusions of the types; "not sufficiently well proven" and "more research is needed" may be understood as *filibuster tactics*: They prevent or delay regulatory tightening. This is a well documented strategy used by industry to defend its own interests:

> Ref. 274: Conway, Erik M. and Oreskes, Naomi: Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, Bloomsbury Press, 2010

One might speculate on the motives and reasons behind the use of research reporting non-findings as evidence. In science theorist and philosopher Karl Popper's hierarchy of evidence, a lack of findings is considered the weakest form of scientific evidence, as lack of findings does not disprove findings and in any empirical study they might have a great many reasons.

> Ref. 275: Pall, Martin: Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action, Reviews on Environmental Health, April 2015
>
> Ref. 276: Mention of Karl Popper: The Logic of Scientific Discovery, German version 1934, English version 1959, p. 19, cited from Wikipedia https://en.wikipedia.org/wiki/The_Logic_of_Scientific_Discovery:
>
> "Popper argues that science should adopt a methodology based on "an asymmetry between verifiability and falsifiability; an asymmetry which results from the logical form of universal statements. For these are never derivable from singular statements, but can be contradicted by singular statements"."

Popper says here that a general proposition cannot be proven by finding single cases, but that general propositions can be disproved by a single case. That is, the statement "All swans are white." cannot be proven by the discovery of white swans, no matter how many, while the discovery of a single black swan disproves the statement. The same, of course applies, to non-findings.

And here we revert to the AMS meters:

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* (Norwegian.) Original title: "Helsevirkninger av elektromagnetiske felt", full link: https://emf-consult.com/rapport-helsevirkninger-av-elektromagnetiske-felt/

There are causes for not finding any biological effects being particularly relevant in connection with *pulse-modulated radio communication*, such as from AMS meters and other modern wireless systems, as well as from dirty electricity emanating from the electricity wires:

Several experiments that do not find biological effects have been carried out without pulse modulation, i.e. only with sine curves at one specific frequency only. E.g. A typical GSM carrier wave frequency has been used, produced by a generator in the laboratory. As *pulse-modulated signals* have long been known to be more biophysically active than non-pulsed, non-findings of such tests are to be expected. They have no scientific evidence in the discussion of health risks from mobile phone use, but may very well be used to cast doubt on studies with positive results.

Martin L Pall identify some research reports which seem designed to produce non-findings in such and other ways, thereby providing (invalid) reasons for building uncertainty around positive findings:

> Ref. 277: Pall, Martin L: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, note dated 17.5.2018, memorandum sent to the European Commission, https://bit.ly/3YLV3gX*

Several researchers, like Pall, have pointed out that attempts must be made with “real communication” to get the effects of pulsing into the picture. Such a claim is intuitively suspicious when seen through the lenses of the physics-based radiation hygiene tradition: “Real communication” means too little control over the parameters in experiments, and you will also more easily get results which contradict the fundamental idea embedded in the term “non-ionizing radiation” – that such radiation can have no biological effects.

Hence, if studying real effects of electromagnetic radiation, it is therefore of utmost importance to use real life radiation sources, even if the implication is that the characteristics will then be harder to describe and the control over the parameters will be less.

However, *the more the realism, the less probable that ICNIRP will accept the finding of any biological effects as certain.*

6.17 Practical consequences of assessment criteria: huge safety zones

While the characteristics of pulses are of importance to biological effects even at extremely low intensities, intensity also matters. For AMS meters, this is relevant for the radiocommunication as well as for the dirty electricity emanating from the wiring.

In this section we revert to *the energy intensity from the radio signals*. It will be shown that if biologically protective exposure limits are adopted, radiocommunication may require safety zones so large that requirements cannot be met. Examples demonstrate the tremendous differences as to safety distances resulting from the basis on which exposure limits are calculated.

Safety distances are specified to protect against health risks from electromagnetic radiation. This is commonly done as part of HSE (health, safety and environment) measures in working life around machines emanating electromagnetic fields, e.g. for plastic welding. In connection with consumer equipment, the indication of safety distances is rarely stated in ways that make consumers familiar to them, and may be subject to great controversy.

* Full link: https://einarflydal.com/wp-content/uploads/2018/10/Pall-ML-5g-emf-hazards-eu-emf2018-6-11us3.pdf

For example, the city council in Berkeley, California, has since 2015 been in conflict with the American wireless industry's trade organisation CTIA whether the customer should be given information, in the form of notices or posters at the points of sale, about recommended safety distances between the body and the mobile phone. Such information is already stated in small print in the User Declaration which appears when buying a new mobile phone. CTIA has argued that requiring such information to be posted at the point of sale contravenes the American Constitution's provisions on freedom of expression.

> Ref. 278: “City of Berkeley to require cellphone sellers to warn of possible radiation risks”, The Guardian, 16.05.2015, https://bit.ly/3Fb53bm*

The case ended (September 2020) with the city council agreeing not to appeal against a federal ruling that such a requirement interferes with the Federal Communications Commission's (FCC) regulation of the industry, in return for CTIA accepting the legal costs.

> Ref. 279: “Berkeley Cell Phone "Right to Know" Ordinance”, Tuesday, December 1, 2020, https://bit.ly/2MCkBaz†

In the following, some examples of safety distances from radio communication equipment are shown. The purpose is to demonstrate the high practical importance for safety distances whether the basis for the calculation is the thermal dogma to which ICNIRP and the WHO adhere – and countries like Norway recommend, or if the risk of biological damage is used as basis for setting exposure limits.

6.17.1 An example: mobile phone masts on rooftops

As to mobile phone masts on roof tops, we often find a poster with warnings on the doors leading out on the roof where the mast is installed. See Figure 74.

The poster claims that a short stay, such as walking through the field within a certain distance from the base stations, does not increase health risks. However, it also states that one should not stay in this field.

In connection with the introduction of 5G, ICNIRP came up with new guidelines in March 2020. These new guidelines recommend exposure limits allowing for far more energy intense short term exposures. They also provide guidelines for calculation which imply that the exposure cannot be measured on site, but must be calculated with methods so far only practicable as a desktop exercise, one exercise per emitting source:

> Ref. 279b: Einar Flydal, Else Nordhagen and Odd Magne Hjortland: ICNIRP's new guidelines for radiation protection are based on professionally untenable documentation, allow for stronger exposure, weaken authorities' and consumers' control options, and legitimise increased health and environmentally harmful infrastructure, such as from 5G, note, 21.05.2020, https://bit.ly/3ZbHUNK‡

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* Full link: https://www.theguardian.com/us-news/2015/may/16/berkeley-california-cellphone-radiation-health-risks

† Full link: https://www.saferemr.com/2014/11/berkeley-cell-phone-right-to-know.html

‡ (Norwegian) title: ICNIRPs nye retningslinjer for strålevern er basert på faglig uholdbar dokumentasjon, åpner for sterkere eksponering, svekker myndigheters og forbrukeres kontrollmuligheter, og legitimerer økt helse- og miljøskadelig infrastruktur, som fra 5G, full link: https://einarflydal.com/utredninger-boker-m-m-a-laste-ned-bestille/

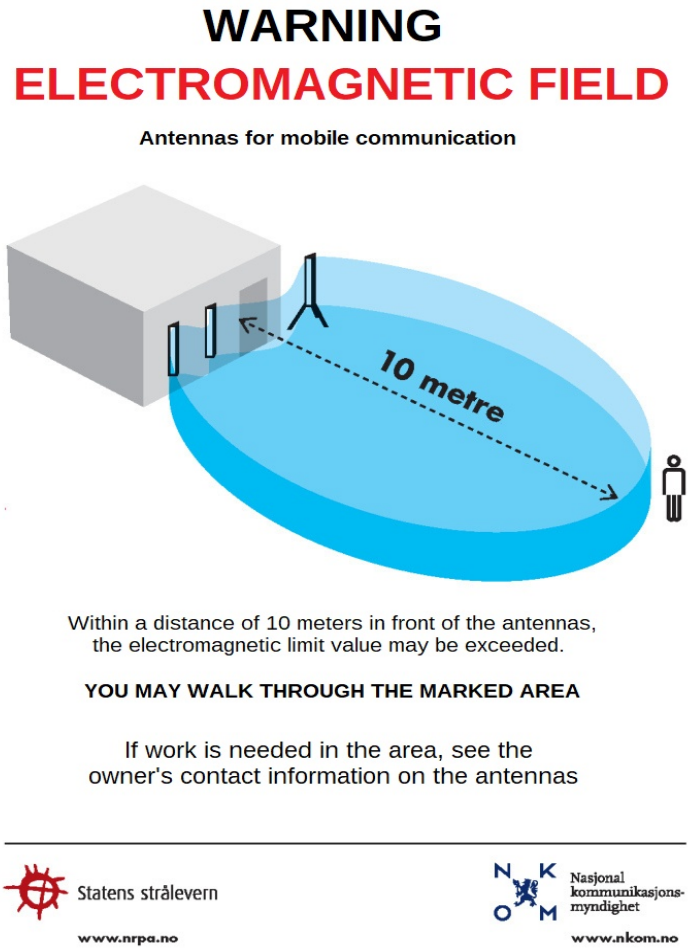

Figure 74: Poster (2021) put up at exit doors to roofs with base stations (Source: NKOM's and DSA's websites, translated)

In connection with 5G base stations that are mounted on roofs, assurances are given on DSA's and NKOM's websites about the lack of health risks. The assurances must be understood as the two agencies guaranteeing that thermally based exposure limits provide sufficient radiation protection:

> Ref. 280: Guidance poster from NKOM and DSA on safety distances from base stations on roofs, https://bit.ly/3JvUWAj*

In the guidance, issued prior to 5G launch, the following is stated – downplaying the fact that 5G technology opens for far greater exposure and that serious objections have been put on the table as to the safeness of the method risk is calculated:

> "Telecom operators in Norway, the National Communications Authority (NKOM) and the Directorate for Radiation Protection and Nuclear Safety (DSA) have collaborated to develop advice and guidelines for traffic on roofs where mobile antennas are installed. …
>
> With the introduction of 5G, some antennas will have a transmission pattern which makes it necessary to bring in nuances about communications on roofs where such antennas are mounted. …

* Full link: https://www.nkom.no/fysiske-nett-og-infrastruktur/elektromagnetisk-straling#ferdsel_p_tak_hvor_mobilantenner_er_montert

Existing information shows that one may experience that the limit value is exceeded within a range of up to 10 metres in front of a mobile antenna.

With today's rapid development of mobile communications technology and the introduction of 5G, some antennas will have a transmission pattern implying that the current information is not necessarily correct, and that the limit value may be exceeded in short moments even outside the marked safety zone. Although the exposure for short moments may be somewhat higher than stated, there will still be no risk of harm to health as long as the existing advice is followed.

The authorities follow the development, and until standardised measurement methods and configurations for 5G are in place, the existing poster applies."

Ericsson, one of the world's leading manufacturers of transmission equipment for 5G, stated in 2017 that the safety zones from 5G base stations would be as shown in Figure 75, depending on the bases on which exposure limits are set: The three illustrations show an apartment block with a 5G mast on top and the safety zones resulting under the various radiation regimes in the table below. The three pictures show that the safety distances become enormous if biologically based.

Illustrations and numbers in Figure 75 are taken from a briefing given by Ericsson in 2017 on the requirements for safety distances based on ICNIRP's guideline exposure limits as of 1998.

Ref. 281: Christer Törnevik, Senior Expert, EMF and Health, Ericsson Research, Stockholm: Impact of EMF limits on 5G network roll-out, ITU Workshop on 5G, EMF & Health, Warsaw, December 5 2017, https://bit.ly/3LkTK4p*

The three illustrations show, from the left, a huge apartment block with 5G base stations on the roof, and with safety zones around based on the ICNIRP 1998 guideline (yellow); then the same apartment block with Israel's and India's safety zones marked in blue; and to the right the same building block with security zones according to exposure limits used in Poland, Italy, China, parts of Canada and Switzerland, etc. (all by 2017, identical scales):

Local regulations	**Safety distances**
The Nordic countries and other countries applying ICNIRP's 1998 guideline values	11 metre radius at 7 meter height (marked with a yellow zone around the antenna)
Israel and India	37 metre radius at 23 meter height
Poland, Italy, China, parts of Canada and Switzerland, and others	115 metre radius at 70 meter height

Figure 75: Safety distances around a 5G antenna on an apartment block. At thermally and biologically calculated exposure limits (Törnevik, Ericsson, 2017)

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

Exposure limits are set much lower in certain regions, e.g. Luxembourg, Ukraine, the city of Brussels, parts of Italy and Liechtenstein. Safety distances would necessarily be correspondingly much wider. Ericsson's presentation stated that it would simply be impossible to introduce 5G in cities with such safety distances. To revise the exposure limits of ICNIRP 1998 was thus of decisive importance for the industry and for other stakeholders of the technology. We shall see that safety distances is a similar problem as to mobile phones and AMS meters.

6.17.2 Example: Safety distance for mobile phones

The “Conditions for use” for mobile phones, displayed when new smartphones are initialized, normally state that the device must be kept away from the body and that exposures are measured at a distance of around 1.5 cm. Such measurements normally show values within the requirements expressed as *SAR values* (Specific Absorption Rate), an industry standard that is supposed to prevent damage in human tissue from acute heating.

Samsung provides the following recommendation, which warns against induction in metal items close to the mobile phone, since they may act as antennae:

> Ref. 282: Mobile Terms and Conditions, Samsung, https://bit.ly/421ELlz*
>
> “Body-worn operations are restricted to belt-clips, holsters or similar accessories that have no metallic component in the assembly and must provide at least 1.5 cm separation between the device and the user's body.”

Translated into everyday language (by us) this means:

> *Samsung warns against health issues that may result a) if you carry the phone less than 1.5 cm away from your body, or b) next to metal items being that are close to your body.*

If by contrast, the EUROPAEM guidelines’ precautionary-based maximum exposure recommendations are used as reference to calculate safe distance, safe distance would be *around 5 metres*.

6.17.3 Safety distances for AMS meters

For AMS meters, no safety distance is specified during installation and no warnings about increased health risks are given. AMS meters' maximum transmission power, which normally is automatically used by the meters after power outages, when the mesh network is disturbed, and after software updates, is set by regulations to 0.5 Watt e.r.p., which is 3 to 4 times the maximum transmission power permitted from 2G, 3G and 4G mobile phones. (NOTE! Mobile phones’ max transmission power is normally expressed as 2 Watt e.i.r.p. However, e.r.p. and e.i.r.p. are two different measurement methods and therefore not comparable. This creates confusion, even with the authorities.)

Although safety distances for AMS meters are not stated, one may derive what safety distances are reasonable by comparing estimated exposure from AMS meters to exposure limits recommended by the guidelines.

* Full link: https://www.samsung.com/us/support/legal/mobile/#health-and-safety-information, as by spring 2021.

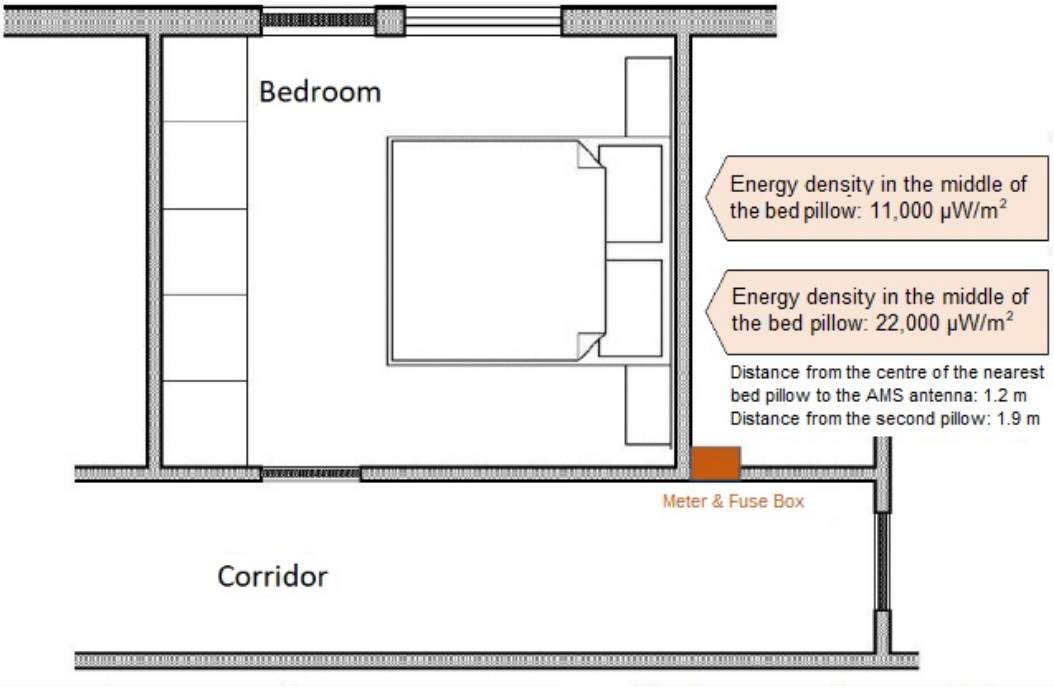

Figure 76: Calculated exposure in a bedroom for a head in the middle of the bed pillows (J. Ravndal, from Grimstad & Flydal 2018, Part 2, p. 65)

Figure 76 above shows estimated exposures in a practical situation: an entrance hall where the AMS meter is located in the fuse box, and an adjacent bedroom. The estimations in Figure 76 and in the table below (Figure 77) were carried out by professional electronics engineer Jostein Ravndal. The table shows the calculated exposure at the nearest bed pillow, as well as ICNIRP's recommended exposure limits for frequencies used by the three most common AMS meters in Norway. Values from the EUROPAEM guidelines are also given. The two figures are reproduced from:

> Ref. 283: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, 2018, https://bit.ly/3BI97h3* Part 2, Section 3.2.

Estimated exposure (µW/m²)	**AMS meter manufacturer**	**Frequency (MHz)**	**Recommended exposure Limits (µW/m²)**		
			ICNIRP	**EUROPAEM**	
Bed pillow 1, at 1.2 m distance				**At night**	**For the extra sensitive**
29,000*	Kamstrup	444	2,220,000	10	1
29,000	Nuri, Aidon	870	4,350,000	1	0.1

Figure 77: Calculated exposure in bedrooms compared to ICNIRP and EUROPAEM limit recommendations (J. Ravndal, from Grimstad & Flydal 2018, Section 3.2, Figure 17)

Figure 77 shows that the estimated exposure at the closest bed pillow is 29,000µW/m². The ICNIRP guideline limits (1998) are at 2,220,000µW/m² and 4,350,000µW/m², depending on the frequencies used by the meter. In contrast, EUROPAEM guideline recommendations are at 10µW/m², or even at

* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

1μW/m^2, for this type of (pulsed) radiation, depending on the meter's carrier frequency. A tenth of these values is recommended for the extra sensitive (Figure 66).

If ICNIRP's reference values for protection against heating damage are used as a basis, and we do not take into account the uncertainty of *the near field* (see Section 2.14) – which makes the radiation far more powerful and impossible to measure – we may estimate the safety distance for prolonged stays to be *less than 15 cm*.

If, in contrast, we estimate the safety distance on the basis of the EUROPAEM precautionary-based guidelines' recommendations, the radiation from the AMS meters is in the order of 222,000 to more than 40 million times too strong. For 4 million, the safety distance will then be *around 70 metres*.

(The safety distances are obtained by doubling the distance 1.2m until the value 29,000μW/m^2 is reduced to around 10 – 0.1μW/m^2: The exposure is reduced to ¼ when the distance is doubled.)

The safety distance derived from EUROPAEM's recommendations may explain the anecdotal evidence in the form of reports from people who without warning nor being aware of what was going on, were hit by acute illness when neighbours in residential areas had AMS meters installed, or suffer from severe illness from AMS meters installed in the stairways of concrete buildings, etc. The safety distance derived from the ICNIRP guidelines are not able to explain such illness and thus fail in their ability to predict health effects from such EMF exposure. Thus, the EUROPAEM guidelines have explanatory power, while the ICNIRP guidelines have not.

Theoretical calculations and comparisons made by the physicist Ronald M. Powell give similar results based on a comprehensive physics-based review which he has carried out, based on research identifying radiation intensity thresholds for health issues. See Figure 78. The figure shows a *safety distance close to zero metres* at the FCC's recommended exposure limits (blue band), as opposed to *around 200m* based on the EUROPAEM guidelines (yellow band) – under ideal conditions with only one transmitter in the area and no reflection, interference, concentration or attenuation.

> Ref. 284: Powell, Ronald M.: Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances, paper, 11. June 11, 2013, https://bit.ly/3ytIFq3*

As reference for exposure limits for pulsed radiation, Powell uses the proposal set forward by the very comprehensive BioInitiative Report (2012 version). See Ref. 285. According to its own statement, this report of 1,479 pages reviews around 1,800 recent (as of 2012) peer-reviewed studies.

The BioInitiative Report suggests an "effect limit" of *3 – 6μW/m^2* (or 0.003 – 0.006μW/cm^2). This means that a precautionary limit is recommended, in accord with the principle that *any influence found to interfere with biological processes in a harmful direction, implies a potential for harm that should be avoided*:

> Ref. 285: Bioinitiative Working Group, David Carpenter and Cindy Sage (eds). *Bioinitiative 2012: A rationale for biologically-based exposure standards for electromagnetic radiation*, *https://bioinitiative.org/*. Section 1 Summary for the Public, (2014 Supplement) Summary for the Public – Cindy Sage, IV. RECOMMENDED ACTIONS, B. Defining new 'effect level' for RFR, last paragraph, unpaginated.
>
> "A scientific benchmark of 0.003 μW/cm^2 or three nanowatts per centimeter squared for 'lowest observed effect level' for RFR is based on mobile phone base station-level studies.

* Full link: https://skyvisionsolutions.files.wordpress.com/2013/06/powell-report-bioinitiative-report-2012-applied-to-smart-meters-and-smart-appliances_june_11_2013.pdf

Applying a ten-fold reduction to compensate for the lack of long-term exposure (to provide a safety buffer for chronic exposure, if needed) or for children as a sensitive subpopulation (if studies are on adults, not children) yields a 300 to 600 picowatts per square centimeter precautionary action level. This equates to a 0.3 nanowatts to 0.6 nanowatts per square centimeter as a reasonable, precautionary action level for chronic exposure to pulsed RFR. Even so, these levels may need to change in the future, as new and better studies are completed. This is what the authors said in 2007 (Carpenter and Sage, 2007, BioInitiative Report) and it remains true today in 2012.

We leave room for future studies that may lower or raise today's observed 'effects levels' and should be prepared to accept new information as a guide for new precautionary action."

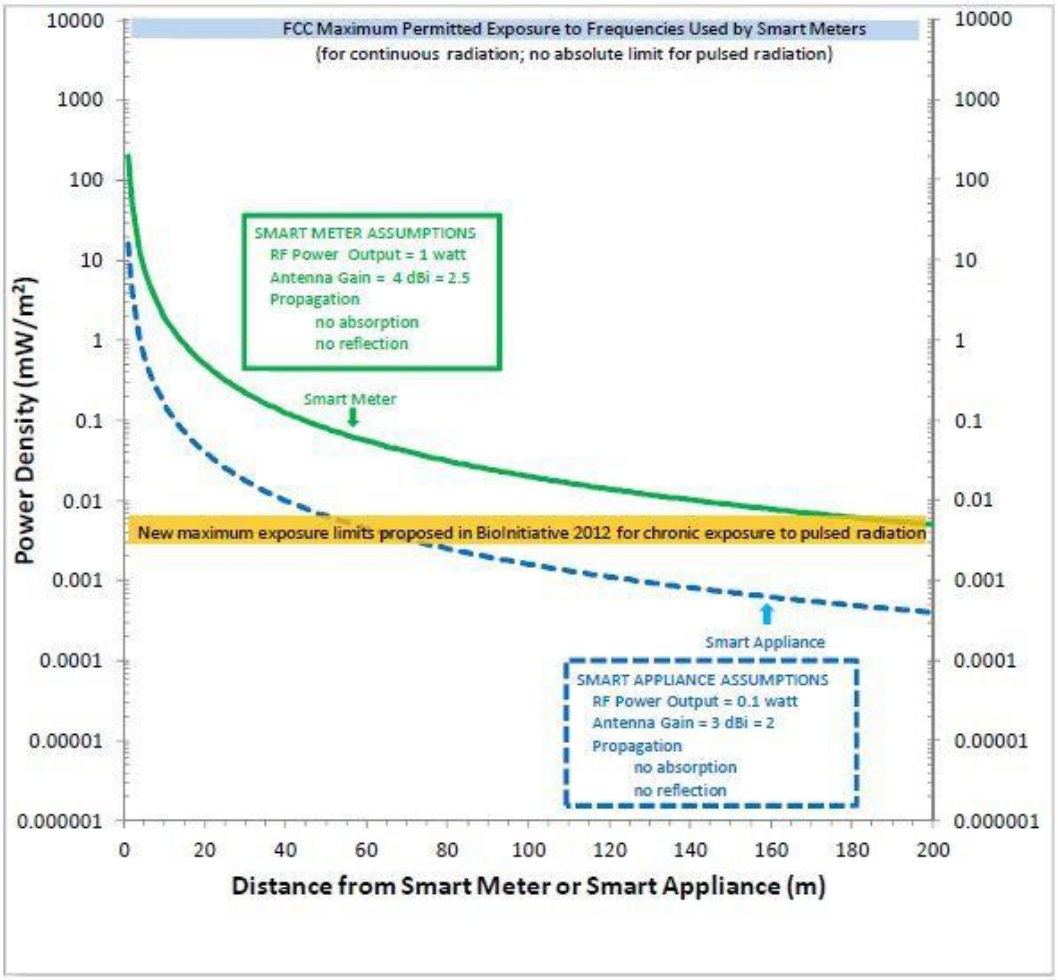

Figure 78: Safety distance in terms of BioInitiative's recommendations and FCC versus exposure at different distances for AMS meters and associated "smart equipment" (Powell 2013, figure 1, page 9)

Figure 78 shows that the intended "smart" applications for wireless control of different household appliances would, based on the same exposure limits, require a safety distance of *approx. 60 metres*. Hence, in practice they could not possibly be used.

Ref. 286: Powell, Ronald M.: Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances, paper, 11. June 11, 2013, https://bit.ly/3ytIFq3*, Figure 1, page 9

* Full link: https://skyvisionsolutions.files.wordpress.com/2013/06/powell-report-bioinitiative-report-2012-applied-to-smart-meters-and-smart-appliances_june_11_2013.pdf

Powell ranks the relevant studies reviewed by the BioInitiative Group, demonstrating *biological effects*, i.e. at exposure levels weaker than the exposure limits resulting from the thermal criterion. (Powell refers to exposure limits recommended in USA by IEEE and FCC, which for all practical purposes may be considered equal to ICNIRP's guidelines.)

Figure 79 shows at which recorded exposure intensities damage has been detected in these studies. Powell then uses these studies to identify the distance needed to stay below these exposure levels where harmful effects have been detected. The figure also states how many studies are found in each group, the kind of effects found in the respective studies, and gives references to the studies.

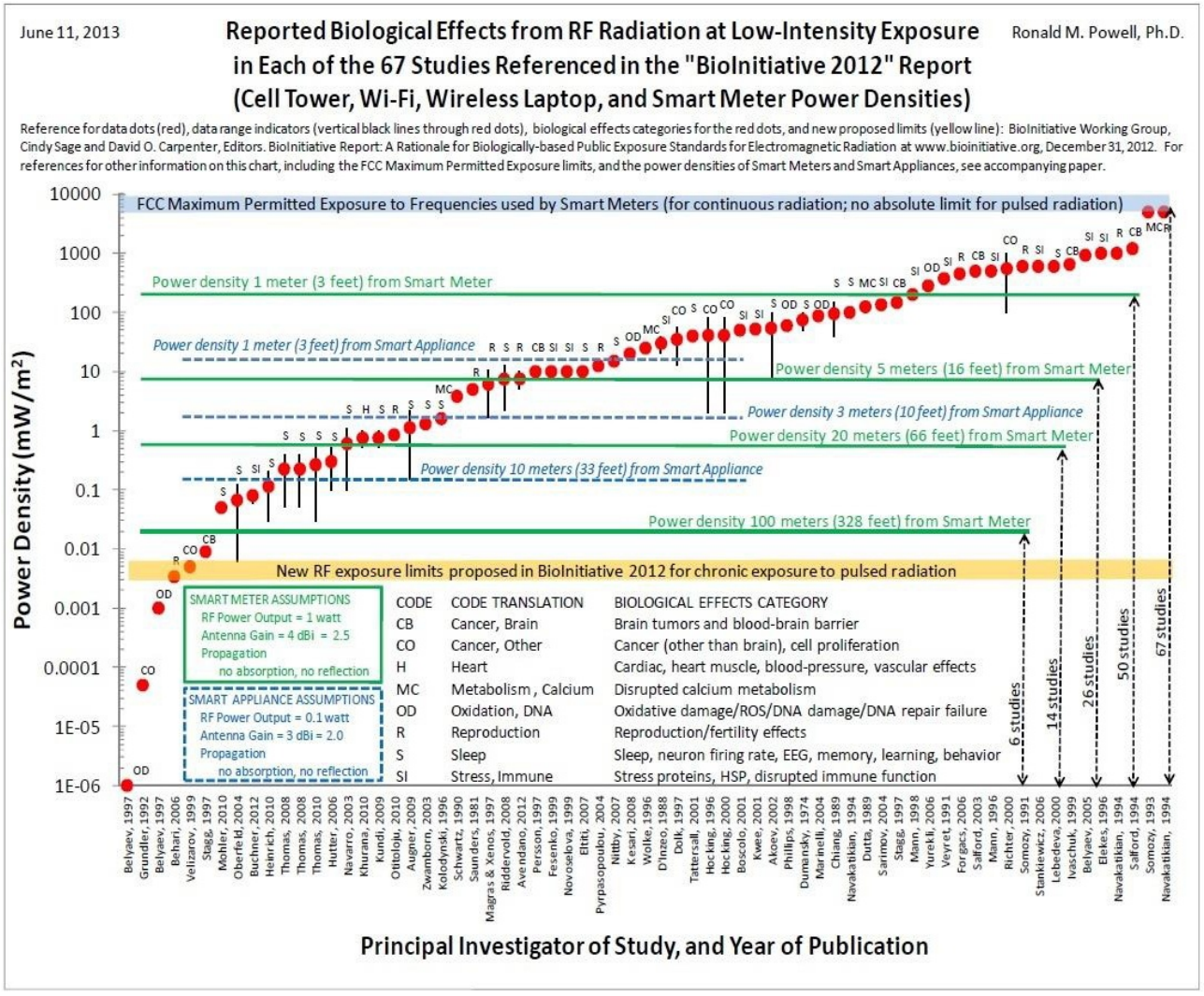

Figure 79: Studies having found biological effects ordered by exposure intensity threshold level, necessary safety distance according to BioInitiative exposure limits, number of studies found and category of biological effect. (Powell 2013)

In Figure 79:

- The vertical axis shows the exposure intensity (power density). *Note!* A logarithmic scale, i.e. each indicated value is 10 times higher than the one below.
- The blue line at the top shows the current limit value in the USA (and e.g. Norway).

- Green lines show the exposure intensity at a distance of 1 metre from the meter, 5 metres, 20 and 100 metres, respectively.
- **Black dotted arrows** tell the number of studies having found adverse effects at weaker exposure than where the arrows end.
- Red dots show the individual scientific reports, with references to the respective studies below the horizontal axis and abbreviations for the respective biological effect categories just above,
- Yellow band shows The BioInitiative Report's proposed exposure limit.

Powell finds (reproduced from Powell's summary, pp. 11 ff.):

1. The authorities' exposure limits are set so high that they have no practical relevance for protecting the population.
2. The proposal for exposure limits from the Bioinitiative Group would protect against the radiation damage found in almost all of the referenced scientific papers Powell picked from this expert group's 2012 research review.
3. A single “smart meter” mounted on the outer wall of a residential building (as normally done in the US) may exceed the radiation levels identified to cause damage in most or many of these reports.
4. Radiation from household appliances intended to communicate with a “smart meter” may exceed the radiation levels found to cause health issues in half or fewer of the reports.
5. A single “smart meter” mounted in your closest neighbour’s detached house (one of eight possible in the case of a simple 3 by 3 table with yourself in the middle) may produce radio frequency radiation with higher intensity levels than those causing health effects in many of the 67 scientific studies listed in Figure 79.

If the ambition is to avoid adverse health effects in the population, then the proposal for exposure limits for pulsed radiation put forward by the BioInitiative Group seems relevant.

Based on Powell's analyses and biologically based guidelines, it may be argued that the safety distances of 70 metres for Norwegian AMS meters and 60 metres for “smart” household appliances seem reasonable, but with the consequence that such appliances should not be used at all.

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We have demonstrated that whichever basis is chosen for estimating exposure limits is extremely consequential. It not only predetermines at what level exposure limits are set, but also the degree to which adverse health effects are taken for real, the relevance the exposure limits have as protection against adverse health effects and the assessments of whether smart meter technology is at all politically and socially feasible.

In practice, we have demonstrated that present exposure limits run against reasonable goals for public health policy, which should include protecting the general public as well as the particularly sensitive, and – as much is still unproven – be based on a precautionary approach.

Still, strong forces are set in motion to make exposure limits laxer, also with the intention – one must assume – to dissociate from responsibility and transparency.

6.18 The internal logic relieving the national radiation protection authority from caring about health and environmentally destructive "weak radiation"

We here show – for the particular case of Norwegian public administration – how the authority in charge has arranged for, whether by ignorance or intention, a circular argument to construct and defend a radiation regime which is as lax as possible.

We suggest similar circular arguments might be used also in other countries.

Through a set of revisions of the Norwegian Radiation Protection Regulations, all exposure below the ICNIRP guidelines' reference values for avoidance of thermal damage fall outside the responsibility of the radiation protection authority. This is constructed through a kind of circular reasoning. This is demonstrated in the following:

ICNIRP's guidelines are automatically applicable regulations in Norway:

> Ref. 287: Regulations on radiation protection and use of radiation (radiation protection regulations), Section 6, paragraph 5, https://bit.ly/40Hn2hk*
>
> "Where there are no national guidelines and exposure limits in optical radiation and electromagnetic fields, the most recently updated version of the Guideline on limited exposure to Non-Ionizing Radiation from the International Commission for Non-Ionizing Radiation Protection (ICNIRP) is indicative of what is considered to be *good practice*." (Italics applied for emphasis.)

Hence, as no damage below ICNIRP's reference values is accepted as sufficiently documented, all exposure below the ICNIRP guidelines is automatically considered within "good practice". In the following, the regulations dictates "good practice" to be adhered to, and – when so done – all radiation at such levels will by definition be regarded as acceptable, outside DSA's scope of work, and therefore not subject to further regulation by DSA:

> Ref. 288: Regulations on radiation protection and the use of radiation (radiation protection regulations), Section 2, https://bit.ly/40Hn2hk
>
> "All radiation use must be justified. This means that the advantages must be greater than the disadvantages caused by the radiation.
>
> The use of radiation must be optimised. This means that exposure to ionizing radiation must be kept as low as practically possible, technological knowledge, social and economic conditions taken into account.
>
> For non-ionizing radiation, all human exposure must be kept as low as *good practice* dictates." (Italics applied for emphasis.)

This area of work – effects on people and/or the environment from exposures below the ICNIRP reference values to protect against thermal damage – is therefore simply not included in the task descriptions of the DSA, the Norwegian radiation protection authority, as far as we have reviewed them, and therefore also not financed. For further details, see

* (Norwegian) original title: Forskrift om strålevern og bruk av stråling (strålevernforskriften), FOR-2016-12-16-1659, Full link: https://lovdata.no/dokument/SF/forskrift/2016-12-16-1659?q=Råevernsprescriptionen

> Ref. 289: Flydal, E: Business audit of Strålevernet – Season 1, episode 5, blog post, 26.06.2019, https://bit.ly/3J6Xjs9*

In this way, the radiation protection regulations and the rejection of all evidence of harmful effects below the exposure thresholds for thermal damage create a circular chain of reasoning. This chain is often reflected when that authority's spokespersons or spokespersons of other entities leaning on their arguments, defend their views. We have previously in

> Ref. 290: Flydal, E: The smart meter radiation and the big disclaimer: The radiation protection authority as Erasmus Montanus, blog post 28.03.2018, https://bit.ly/3Jzgf46†

described this circular chain of reasoning the following way:

1. Through a request to the Ministry of Health, the Norwegian Radiation Protection Authority (DSA) arranged for a change in the law implying that ICNIRP's guidelines are by law automatically Norwegian regulations (untranslated, i.e. inaccessible to most people).
2. Hence, an obligation under the law was created "to follow ICNIRP".
3. The knowledge status reviews DSA chooses to adhere to, conclude that there has not been found a sufficiently reliable science based foundation for stricter exposure limits than the ICNIRP guidelines' reference values for the prevention of acute thermal damage.
4. Thus, the ICNIRP guidelines' reference values are considered sufficient as recommended exposure limits.
5. "Good practice" does by definition provide adequate radiation protection.
6. "Good practice" is in Norwegian radiation protection regulations defined as "following ICNIRP's guidelines".
7. Thus, to follow the ICNIRP guidelines is, by definition good practice and provides for adequate radiation protection.
8. As long as the ICNIRP reference values are practised as exposure limits, there can, by definition, be no health effects, neither positive nor harmful.
9. All forms of electrotherapy and other sub-thermal therapeutical use of non-ionizing radiation are by definition unscientific, and should be opposed, as well as all claims that one might possibly gets health issues from electromagnetic fields below the thermally based energy intensity thresholds given by the ICNIRP reference values.
10. For adequate radiation protection, it suffices for DSA to manage the regulations and monitor whether there are any reasons for change that come from the committees ordered to carry out knowledge reviews by the authorities to which the DSA adheres.
11. These committees are part of an established network [by some called the ICNIRP cartel], to which DSA is also linked. This network consequently rejects non-thermal effects as not sufficiently well proven.
12. In other words, DSA can take it for granted that there will be no demands for more restrictions.

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* (Norwegian) original title: Virksomhetsrevisjon av Strålevernet – Sesong 1, episode 5, 26/06/2019. Full link: https://einarflydal.com/2019/06/26/virksomhetsrevisjon-av-stralevernet-sesong-1-episode-5/

† (Norwegian) original title: Smartmåler-strålingen og den store ansvarsfraskrivelsen: Strålevernet som Erasmus Montanus, 28/03/2019. Full link: https://einarflydal.com/2019/03/28/smartmaler-stralingen-og-den-store-ansvarsfraskrivelsen-dsa-som-erasmus-montanus/

13. In other words, DSA does not need medical expertise, nor to carry out follow-ups, monitoring or checks as long as equipment does not cause exposure levels above ICNIRP's reference values for thermal damage of human tissue, since damage cannot happen when ICNIRP’s reference values are respected.

14. As health effects are not caused by equipment that follows good practice, medical expertise on the health effects of such weak radiation is not needed in the Norwegian health service.

15. As ICNIRP/WHO has uttered: Reactions to non-ionizing radiation exposure are just as real for the patient, and must be taken seriously, even if there are other causes. These causes, if they are not biological, must necessarily be psychiatric.

16. The radiation protection authorities of the Nordic countries agree to agree on the radiation protection policy.

17. Thus, the Norwegian Radiation Protection Authority (DSA) may justify its policy by pointing to other countries’ policy on the matter, and vice versa.

18. In other words, the Norwegian radiation protection policy is built on a safe and sound foundation.

Against this background, it goes by itself that DSA claims all equipment that does not cause acute heating damage to be safe. It also follows that DSA (and NKOM) therefore have no need to follow up and monitor exposure from equipment not causing thermal damage.

It is therefore also reasonable that DSA should not have any responsibility for health effects from electronic consumer equipment or from small installations with effects (i.e. transmission power) which cannot exceed ICNIRP's reference values at their prescribed minimum distance.

In correspondence with the DSA, the Norwegian Directorate of Health, the Ministry of Health and other governmental authorities the responses frequently contain larger or smaller parts of this logic.

6.19 ICNIRP’s caveats as well as obvious gaps in knowledge are neglected by the national radiation protection administrations

ICNIRP explicitly warns that children, the chronically ill and the elderly may need stricter exposure limits than the general public, and that ICNIRP’s recommendations may be too lax for persons with electronic and metals implants, such as pacemakers and artificial joints. Here we show how ICNIRP’s caveat is neglected by the Norwegian radiation protection administration as well as by other RPA’s with identical policies.

How can it be that the Norwegian Directorate of Health and the government’s agency responsible for radiation protection, DSA, conclude so confidently that the radiation from AMS meters is too weak to have any health impacts, when ICNIRP's own guidelines explicitly state that the guidelines may not provide adequate protection for certain sensitive groups or individuals?

ICNIRP explicitly warns that children, the chronically ill and the elderly as well as persons with metal and electronics implants may need stricter exposure limits than the population at large. However, these reservations, which call for more open investigations and restrictive exposure limits, is neglected by the radiation protection agency DSA, which therefore seems in conflict with ICNIRP’s guidelines.

In Norway, the Section 6 of the Radiation Protection Regulations (Ref. 288) states that the latest updated version of ICNIRP's “Guidelines on limited exposure to Non-Ionizing Radiation” applies

as a regulation. ICNIRP's guidelines have been drawn up in accordance with an overarching ICNIRP policy document. In a regulatory hierarchy, also the policy document therefore also becomes part of the Norwegian regulations:

> Ref. 291: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002

ICNIRP 2002 states that the guidelines have been developed for the general public. In the section People being protected, page 546, exceptions are made for children, the elderly and some chronically ill, as well as for surgery leaving people with various implants and other situations where the radiation can obviously have an effect even if it does not provide heating (excerpt from the English text, *italics applied for emphasis*):

- Different groups in a population may have differences in their ability to withstand a certain type of exposure to electromagnetic fields. For example, *children, the elderly and some chronically ill people* may have a lower tolerance for one or more types of electromagnetic exposure than the rest of the population. In such circumstances, it *may be useful or necessary to establish separate guidelines or adjust the guidelines to include such groups*.
- Even if so done, the guidelines may still not provide adequate protection for *certain sensitive individuals*... When such situations are identified, appropriate specific recommendations should be drawn up...
- However, there are some exposure scenarios that are defined as being outside the scope of these guidelines. …. Medical procedures may use EMF, and metallic implants may change or interfere with EMF in the body, which in turn may affect the body either directly (via direct interaction between field and tissue) or indirectly (via an intermediate conductive object). ... and radio frequency EMF may indirectly cause harm by inadvertently interfering with active medical implanted equipment (see ISO 2012) or altering EMF due to conductive implants nearby.

Also, in this very same document (Ref. 291, p. 444, col. 2) ICNIRP opens for *other and less restrictive criteria for causation* than the ones used by ICNIRP to investigate possible health issues from electromagnetic fields other than clearly thermal, and that variations, such as variations between organs and individuals' susceptibilities and exposure situations may make further restrictions needed (*italics applied for emphasis*):

> "In spite of the evaluation process described above [i.e. linking effects to energy intensity thresholds], uncertainties and inconsistencies may still be encountered in comparative evaluations of the literature. Thus, it is recognized that this evaluation is at least partly based on scientific judgements. *Various schemes and "criteria" exist in order to facilitate this judgement process (Hill 1965; IARC 1995).*
>
> For an actual estimate of risk in the general population or in a specific group, the selected studies should provide additional information, including
>
> - the definition of the biologically effective quantity, which may vary with organ;
> - exposure-effect relationship, and identification of a threshold, if any;
> - *exposure distribution and identification of sub populations with high exposure*; and
> - *differences in susceptibilities within a population*."

Also, in its report on "Radio-frequency fields in our surroundings" from 2011, DSA states that when exposed to far weaker fields [than the exposure limits] current exposure limits may in some cases not provide the necessary protection against health issues:

> Ref. 292: Radio frequency fields in our surroundings, Measurements in the frequency range 80 MHz – 3 GHz, Radiation Protection Report 2011:6, Post and Telecommunications Authority (now NKOM) and Norwegian Radiation Protection Authority (now DSA), https://bit.ly/42byzrw*

In its Section 5.2 on exposure limits, page 12, it says (*italics applied for emphasis*):

> "Some individual studies have demonstrated other effects from exposures to fields far weaker [than the exposure limits], such as changed ion transport through cell membranes, damage to DNA and influence on the production of stress hormones, but so far the studies *have not been reproduced* and are therefore attributed less weight."

The claims made here that the studies referred to had not been reproduced, might have been correct in 2011. However, it is clear that the effects had been repeatedly demonstrated. In any case, these effects are established as of today, which can be seen, for example, from Martin L. Pall's review of 183 literature reviews (presented in Section 7):

> Ref. 293: Pall, Martin L: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, note dated 17.5.2018, memorandum sent to the European Commission, https://bit.ly/3YLV3gX†

Furthermore, one of a handful documents forming part of the basis for Norwegian health policy as to non-ionizing radiation protection, the above mentioned "the FHI report"

> Ref. 294: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012‡

gives a number of recommendations, including prioritising research areas to "fill existing knowledge gaps". Here are *our extracts* from the report's pages 164-165:

> 9.2.1.2 – WHO research agenda for radio frequency fields
>
> "WHO's new research program will, among other things, recommend research areas which must be prioritized in order to fill existing knowledge gaps, so that a better basis for health risk assessment is achieved" …
>
> "Epidemiology
>
> - Prospective cohort studies on children and young people, where different health effects are studied, such as behavioural and neurological disorders and cancer – **High importance**"…
>
> "Studies on humans
>
> - Further provocation studies on children in different age groups – **High importance**" …

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* (Norwegian) original title: Radiofrekvente felt i våre omgivelser, Målinger i frekvensområdet 80 MHz – 3 GHz, StrålevernRapport 2011:6. Full link: https://dsa.no/publikasjoner/stralevernrapport-6-2011-radiofrekvente-felt-i-vare-omgivelser/StralevernRapport_06-2011.pdf

† or https://einarflydal.com/wp-content/uploads/2018/10/Pall-ML-5g-emf-hazards-eu-emf2018-6-11us3.pdf

‡ Original title: "Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis", (Norwegian with English summary). Full link: https://bit.ly/3Cu9IDW, or https://www.fhi.no/globalassets/2012-3_mobilstraling

"Animal studies

- Effects from RF exposure before birth and early in life, on development and behaviour – **High importance**"

Neither ICNIRP's caveats, nor WHO's research priorities, nor the recommendations given in "the FHI report" are compatible with the firm rejection of risk of adverse health effects from exposures below the ICNIRP recommended exposure limits: *If no risk, such studies would not be important to carry out. If there is a risk, the rejection of risk is not justified.*

We have, thus, demonstrated that ICNIRP's multiple caveats are neglected by the Norwegian radiation protection administration as well as by other RPA's with identical policies – as for example; all Nordic RPAs and several other countries follow the identical policy.

As this negligence is – at least in part – a result of the focus on thermal effects and the negligence of the biological effects of low frequency pulses from radio transmitters, it also has a bearing on the much weaker pulsing typical for "dirty electricity".

6.20 Focus only on humans, not on the others of nature's living beings

Here we consider how today there does not seem to be any Norwegian authority that is responsible for ensuring that guidelines and exposure limits are sufficient to protect animals and plants from the negative effects of non-ionizing radiation.

In an era of an ever increasing flow of products containing radio transmitters and receivers and devices producing "dirty electricity", we have seen that the Ministry of the Environment is responsible for product control, but points towards DSA as soon as radiation issues are on the table (See Section 6.1).

Neither does the Ministry of the Environment have any activities regarding guidelines or exposure limits regarding the impact on animals and plants from non-ionizing radiation. The Ministry leaves the topic to the radiation protection agency, DSA, which does not even mention that topic in its work programme.

Figure 79b: AMS meter in Latvia and effect on nearby thuja shrub (from Firstenberg, mass email of 5.1.2023, http://cellphonetaskforce.org/worldwide-testimonies-about-smart-meters/)

Meanwhile, reports on serious environmental damages are plentiful, e.g:

> Ref. 294b: Waldmann-Selsam, Cornelia: Tree Damage Caused by Radiofrequency Radiation Exemplary Observations from 2005 to 2021 in Germany, slides, May 2022, https://bit.ly/3mE7g8I*

* Full link: https://einarflydal.com/wp-content/uploads/2023/03/Wladmann-Selsam-2023-Tree_damage_caused_by_radiofrequency_radiation-1-1.pdf

In an email to the Norwegian Ministry of Climate and the Environment in March 2019 and July 2019, a layman on the matter, Trond Syvertsen, called for a commitment within the area of environmental effects from man-made electromagnetic fields:

> Ref. 295: Email from Trond Syvertsen to the Norwegian Ministry of Climate (KMD) and the Environment on 4 March 2019 (our translation):
>
> "I see from articles in the media (...) that extensive harmful effects on insects are found in scientific research to be linked radiation from microwave transmitters. Could KMD please inform me about the exposure limits applying as to the exposure to insects, birds and other wild species in Norway? I would also ask for KMD's assessment of whether these exposure limits are adequate to protect our species diversity."

At the time, there did exist extensive overviews of research demonstrating harmful effects on insects and other species. See for example; literature reviews and studies referenced in the 2022 version of

> Ref. 296: Kåss, Ingrid Wreden & Halmøy, Sissel: Harmful effects of radiation from wireless technology and other EMFs are well documented, Collection of sources, references to scientific research and to warnings from the professionals, Folkets Strålevern, 2022, https://bit.ly/3ZVvt9a*, pp. 28 – 32, and p. 46.

In its response, the Ministry limited itself to insects, replying that the ministry "is not aware of any impact on insects having been reliably ascertained" – again bringing us back to the extremely strict criteria for acceptance of evidence discussed earlier in this book. However, the answer, signed by the minister himself, states that the effect of electromagnetic radiation on insects "will now, in the work on the action plan for pollinating insects, be included as a topic to be assessed to gain a knowledge base as inclusive as possible" – probably a result from addressing the Ministry:

> Ref. 297: Reply letter from the Ministry of Climate and the Environment to Trond Syvertsen 17/2914-17. July 2019, https://bit.ly/3YJWSti†

In autumn 2020, two environmental organisations published a literature review concluding that 72 out of 83 peer-reviewed studies had identified mobile phone radiation as a possible and likely cause of the dramatic decline in insect populations, both in Europe and in the rest of the world.

> Ref. 298: Thill A (2020). Biological effects of electromagnetic fields on insects. Supplement to umwelt · medizin · gesellschaft | 33 | 3/2020, https://bit.ly/3YHmqri‡

Similar literature reviews exist for birds, as well as a number of disturbing reports of animal decline, among other things, that animals using the Earth's magnetic field to orient themselves are the first to go extinct due to disturbance from man-made EMFs.

It could be mentioned here, that under terms like "broadcast theory" and similar, there are disturbing studies showing that man's increasingly extensive tampering with the earth's electromagnetic environment is also causing problems for the globe's more extensive ecosystems. This would be too extensive to be covered here in this book.

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* (Norwegian) Original title: "Skadevirkninger av stråling fra trådløs teknologi og annen EMF er godt dokumentert, Kildesamling med forskning og advarsler fra fagfeltet", 2022. Full link: https://www.folkets-stralevern.no/wp-content/pdf/Kildesamling-2022-10-10.pdf

† (Norwegian) Full link: https://einarflydal.com/wp-content/uploads/2023/03/Svar-til-Trond-Syvertsen-fra-KMD-OCR-18072019.pdf

‡ (German) Full link: https://www.emf-portal.org/en/article/43387

6.21 A maximally lax interpretation of the ICNIRP guidelines – a political choice

The Norwegian and similar RPAs systematically interpret the evidence so that maximal elbow room is created for industry, economic growth and military use. Still, there is full freedom for countries to set exposure limits more restrictive than the ICNIRP's guidelines.

A consistent feature we have seen is that the Norwegian health authorities choose, by referring to DSA, to adhere to the ICNIRP's reference values for protection against heating damage, using them as general exposure limits, without setting more restrictive limits to protect against biological damage, i.e. below the thermal limit, nor in order to protect the particularly sensitive. This is legitimised by research review reports that "do not identify sufficiently reliable signs of damage" at lower exposure than thermal.

The Norwegian RPA, DSA, follows such a course well aware of the science reports finding sub-thermal health and environmental damage, and well aware of the abundance of scientific literature reviews considering sub-thermal findings to be of sufficient scientific quality, at least for a precautionary policy. DSA claims it makes no evaluations of its own, and instead just follows ICNIRP, the WHO and reviews like the so-called FHI report of 2012.

The FHI report of 2012, which has since been constantly invoked as a basis for Norwegian health policy in the area, chooses to interpret ICNIRP's guidelines, WHO's frameworks and reviews, and the EU's review (SCENIHR 2015) as *a request to apply the reference values to protect against thermal damage as if they were proposals for exposure limits*. On the contrary, we have seen that, in fact, the ICNIRP and WHO request that the relevant entities should make their own assessments based on the present knowledge status, the application of methods not limited to the thermal paradigm, as well as other relevant considerations.

Thus, the interpretation, as it is also stated in the "FHI report" (2012), is directly contrary to these entities actual message:

> Ref. 299: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012* p 166
>
> "Despite requests from the EU to follow ICNIRP's recommendations, some countries have nevertheless chosen to set stricter exposure limits for specific frequency ranges or applications. ... The exposure limits for these countries are mostly between 0.5 and 70% of the ICNIRP's reference values as to power density."

Hence, this report, invoked as a platform for Norwegian radiation protection policy, argues in contradiction also to the EU's request, being in line with the ICNIRP's and WHO's formulations: The EU sets maximum values, not minimum values. There is thus full access for countries to set exposure limits that are more restrictive than the ICNIRP's reference values to protect against health issues from thermal heating.

As we have seen, and will also see in the following sections of this book, the position taken by the Norwegian authorities is simply at odds with the status of knowledge, when the status of knowledge is decided based on usual scientific methods of proof. Also, it is at odds with the message from

* Original title: "Svake høyfrekvente elektromagnetiske felt – en vurdering av helserisiko og forvaltningspraksis", (Norwegian with English summary). Full link: https://bit.ly/3Cu9IDW, or https://www.fhi.no/globalassets/2012-3_mobilstraling

ICNIRP, WHO and EU. Their actual messages are disregarded or given a maximally lax interpretation in conflict with their guidelines.

7. Typical acute effects of man-made pulsed EMF – without heating

In this section, we take a closer look at the health effects of pulsed EMF way below thermal thresholds, i.e. effects when exposed to radiation weaker than exposure limits recommended by the Norwegian as well as many other radiation protection authorities. We show that pulsed radiation is a likely explanation for acute effects from man-made EMF's below thermal thresholds, whether from radio waves or from electricity wires.

We have seen that *pulsed radiation* is always present where there is radio communication, as well as in the electric fields around power lines. We have seen that there is extensive evidence that such radiation is far more bioactive than non-pulsed radiation.

We have also referred to pulsing as an important source of health damage to humans and animals, and shown that there is extensive research evidence for this and that the evidence is consistent with practical and clinical experience.

Here we show that pulsed radiation is a likely explanation for acute effects from man-made EMF's below thermal thresholds. Through this, it is underpinned that *both radio communication as well as dirty electricity from AMS meters may cause acute health problems,* and that the effects are distributed over a wide range of symptoms, causing increased long-term health burdens on people as well as the environment.

This conclusion also proves that exposure limits set simply on the basis of ICNIRP's reference values cannot be used as a basis for a qualified assessment of the health effects of exposure to electromagnetic fields.

7.1 Symptoms of pulsed radiation

From our contact with electrically hypersensitive people, we are well aware of the symptoms frequently reported as *effects of microwave radiation* from WiFi, mobile masts, mobile phones, AMS meters, etc., i.e. from *pulsed electromagnetic radiation*:

Typical are the hearing of ringing and clicking sounds, sudden ringing in the ears (tinnitus), ear pain, pressure or vibrations in the head, hearing loss, dizziness, unsteady walking and visual disturbances, exhaustion (fatigue), impaired balance, headache, impaired concentration, depression and insomnia.

We have seen these symptoms repeatedly in more or less formal surveys, as shown in Chapter 2, and that roughly the same symptoms are reported by a number of research sources. Here we refer to yet another example – Santini 2003:

> Ref. 300: Santini, R & al: Survey Study of People Living in the Vicinity of Cellular Phone Base Stations, Electromagnetic Biology And Medicine, Vol. 22, No. 1, pp.41-49, 2003, https://doi.org/10.1081/JBC-120020353

Figure 80 shows that symptoms occurred more frequently the closer to a cell phone tower the respondent residents were living and the proportion of the respondents with symptoms "very often" was higher also the closer the person lived to a cell phone tower. The symptoms were, in order of decreasing incidence: *fatigue, sleep disturbance, headaches, feeling of discomfort, difficulty in concentration, depression, memory loss, visual disruptions, irritability, hearing disturbances, skin problems, cardiovascular problems, dizziness, loss of appetite, movement difficulties, nausea*.

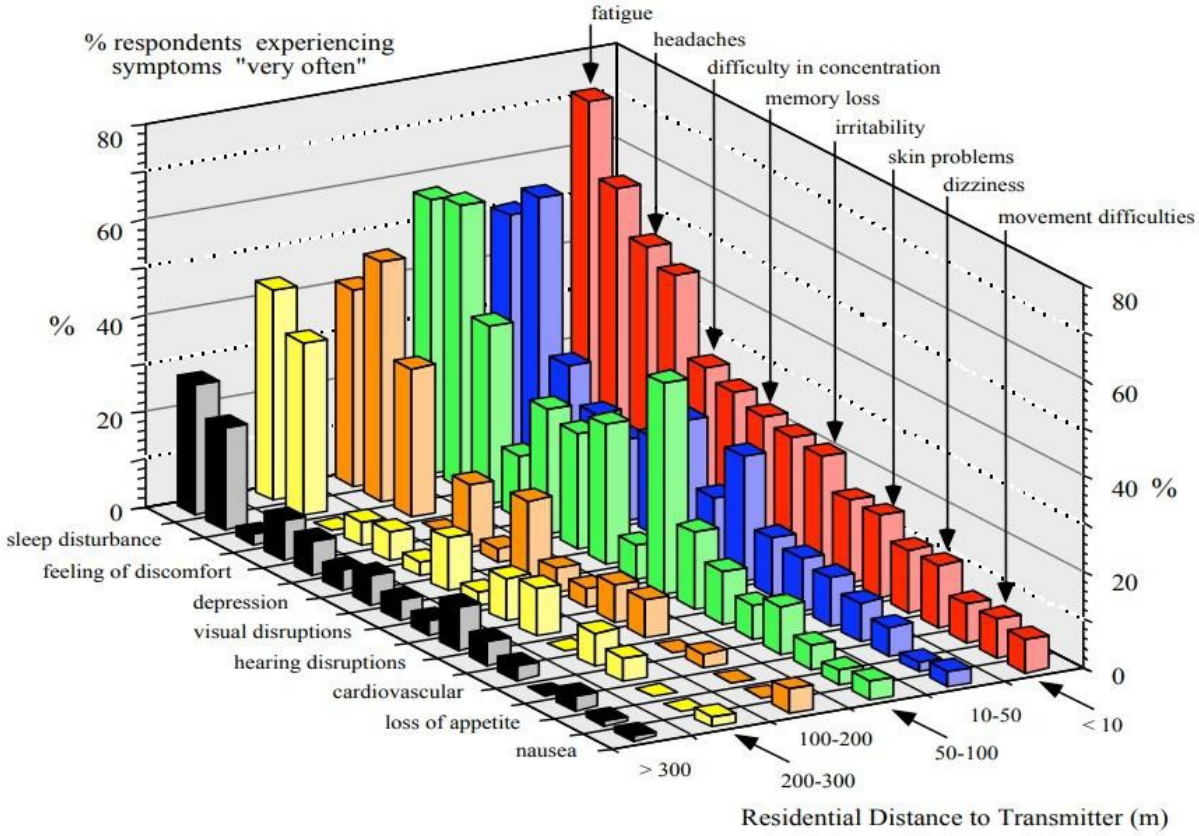

Figure 80: Symptoms and proportion of responding residents with health problems, by to distance from mobile towers (Santini 2003)

7.2 The diplomat's health issues were caused by weak, pulsed radiation

An academically weighty committee under the US National Research Council has prepared a report for the US Department of State based on the many health problems found among US embassy staff members and their families during or after stays abroad, especially in Havana in Cuba and in Guangzhou in China, as well as with Canadian embassy staff members spending their time in the same premises as the US personnel in Havana.

The committee concluded that the damage most likely came from pulsed electromagnetic radiation aimed at the embassies.

> Ref. 301: National Academies of Sciences, Engineering, and Medicine. 2020. An Assessment of Illness in the U.S. Government Employees and Their Families at Overseas Embassies. Washington, DC: The National Academies Press. https://doi.org/10.17226/25889

The report was released autumn 2020. The researchers behind the report assessed possible causes for the many health problems found in embassy staff members and their families. Here again we find the same symptoms.

The report was published by the USA's *National Academies of Science, Engineering, and Medicine*, which is a collaboration between three private foundations with the task of providing advice to the authorities within the fields of scientific research and technology, engineering, medicine and health. Members are selected on the basis of their outstanding contribution to research in their respective fields.

The core of the committee was constituted by around 20 selected professionals from various universities in the USA and a few from outside, e.g. Great Britain. They made reservations as the health data is partly incomplete and that there were no measurements from the embassies of relevant parameters during the time when the cases of illness occurred. The researchers behind the report still considered they had enough data to make a good assessment of what might be the causes behind the cases of ill health.

Their report primarily looks at symptoms found with many of the individuals in question. The symptoms reported by the embassy staff and their families are many and varied, and the overall symptoms are largely related to *the nervous system*. The report divides the symptoms into two categories: *acute and chronic symptoms*, finding the symptoms for which it is easiest to assess the cause, are the acute ones. They consist of *ringing and clicking sounds in the ears, pressure and vibrations in the head, sudden ringing in the ears (tinnitus), ear pain, hearing loss, dizziness, unsteady walking and visual disturbances*. The most common chronic symptoms were *dizziness, fatigue, impaired balance, headache, impaired concentration, depression and insomnia*.

The committee states that these symptoms, especially seen in context, *must be caused by pulsed electromagnetic radiation at very low intensities*, possibly far below the prevailing exposure limits in the USA – which are the same as in Norway and many other countries. Furthermore, they point out that it is to be expected that pulsed electromagnetic radiation may intensify any health problems already present for other reasons, a so-called *interaction effect*.

In toxicology, such enhancing interaction effects are simply to be expected, and has also been demonstrated in several studies, among others by Lerchl et al.:

> Ref. 302: Lerchl A et al. (2015): Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Biochem Biophys Res Commun 2015; 459 (4): 585-590, https://bit.ly/400lPCi*

Lerchl's findings are particularly interesting, as Alexander Lerchl, a researcher and member of Germany's National Council for Non-Ionizing Radiation Protection, has since 2008 accused Adlkofer and his major EU project REFLEX of research fraud. Lerchl mainly attacked this large project that demonstrated DNA damage in cell cultures as an effect of weak, pulsed, radio frequency radiation, which he claimed to be the result of falsified data. The case was pending in the legal system for a long time, until in December 2020 Lerchl was finally convicted of making baseless accusations.

> Ref. 303: The Hanseatic Higher Regional Court in Bremen has sentenced Professor Alexander Lerchl to withdraw his allegations of falsification of the REFLEX study, https://bit.ly/3lrfgK6†

7.3 The committee's assessment of the scientific evidence

Here are excerpts from the committee's assessment of the scientific evidence. Their conclusion was that the symptoms reported by the many embassy employees and their families are health effects from pulsed electromagnetic radiation.

The American research committee presented extensive scientific evidence for its conclusion. It referred to this evidence as follows (our extract, our comments in [brackets]):

---

* Full link: http://www.fraw.org.uk/data/esmog/lerchl_2015.pdf

† Full link: https://pandora-foundation.eu/2021/02/22/a-higher-regional-court-in-germany-orders-professor-alexander-lerchl-to-retract-his-falsification-allegations-against-the-reflex-study/

Ref. 304: National Academies of Sciences, Engineering, and Medicine. 2020. An Assessment of Illness in U.S. Government Employees and Their Families at Overseas Embassies. Washington, DC: The National Academies Press. https://doi.org/10.17226/25889

"There are multiple possible mechanisms for non-thermal RF biological effects, including apoptosis [cell death, etc] and cell oxidative stress (Barnes and Greenebaum, 2018; Ilhan et al., 2004; Salford et al., 2003; Steiner and Ulrich, 1989; Zhao et al., 2007). RF-induced, non-thermal cell membrane dysfunction (Ramundo-Orlando, 2010) can occur from coherent excitation (Fröhlich, 1988) above 1 GHz due to a variety of effects including electroporation, metabolic changes, pressure fluctuations, and voltage gated calcium channel disruption (Pall, 2013, 2016). However, many of the cognitive, vestibular [re. balance, etc.], and auditory effects observed in DOS personnel are most consistent with modulated, or pulsed, RF biological effects. [and *not* with continuous, i.e. sinusoidal-shaped RF, etc.]

There was significant research in Russia/USSR into the effects of pulsed, rather than continuous wave (CW) RF exposures because the reactions to pulsed and CW RF energy at equal time-averaged intensities yielded substantially different results (Pakhomov and Murphy, 2000, p. 2)."

…

"Pulsed RF effects on the nervous system can include changes to cognitive (D'Andrea, 1999; Lai, 1994; Tan et al., 2017), behavioral (D'Andrea and Cobb, 1987), vestibular (Lebovitz, 1973), EEG during sleep (Lustenberger et al., 2013), and auditory (Elder and Chou, 2003) function in animals and humans, though many RF exposure characteristics (carrier frequency, pulse repetition frequency, orientation, power densities, duration of exposure) complicate direct comparisons of different experiments (D'Andrea et al., 2003)."

…

"The benefits derived from purposeful short-term exposures to therapeutic neuromodulation contrast with the adverse neurologic and neuropsychiatric symptoms described by individuals exposed to electromagnetic fields (e.g., high tension electrical transmission cables) over longer periods of time (Pall, 2016) as summarized by Stein and Udasin (2020)."

In the above paragraphs, the American Research Committee rejects in a concentrated form almost the entire foundation for the use of ICNIRP's reference values as exposure limits – as such a practice is based on the idea that biological health problems and damages cannot be detected with reasonable scientific certainty below the thermal level. Simultaneously, the foundation for the Norwegian health policy within this area, as well as the current recommended exposure limits are disapproved.

Listed here are the full references to the scientific studies cited in the extract above. Hence, these are the scientific works forming the basis of the US-American researchers' assessments:

Barnes, F., and B. Greenebaum. 2018. Role of radical pairs and feedback in weak radio frequency field effects on biological systems. Environmental Research 163:165-170.

D'Andrea, J. A. 1999. Behavioral evaluation of microwave irradiation. Bioelectromagnetics Suppl 4:64-74.

D'Andrea, J. A. and B. L. Cobb. 1987. High-peak-power microwave pulses at 1. 3GHz: Effects on fixed-interval and reaction-time performance in rats. Naval Aerospace Medical Research Laboratory Report #1337.

D’Andrea, J. A., C. K. Chou, S. A. Johnston, and E. R. Adair. 2003. Microwave effects on the nervous system. Bioelectromagnetics Suppl 6:S107-S147.

Elder, J. A., and C. K. Chou. 2003. Auditory response to pulsed radiofrequency energy. Bioelectromagnetics Suppl 6:S162-S173

Fröhlich, H. 1988. Theoretical physics and biology. In Biological coherence and response to external stimuli, edited by H. Fröhlich. Berlin, Germany: Springer-Verlag. Pp. 1-24.

Ilhan, A., A. Gurel, F. Armutcu, S. Kamisli, M. Iraz, O. Akyol, and S. Ozen. 2004. Ginkgo biloba prevents mobile phone-induced oxidative stress in rat brain. Clinica Chimica Acta 340(1-2):153-162.

Lai, H. 1994. Neurological effects of radio frequency electromagnetic radiation. In Electromagnetic Fields in Living Systems, Vol. 1, edited by J. C. Lin. New York: Plenum Press.

Lebovitz, R. M. 1973. Caloric vestibular stimulation via UHF-microwave irradiation. IEEE Transactions on Biomedical Engineering 20(2):119-126.

Lustenberger, C., M. Murbach, R. Durr, M. R. Schmid, N. Kuster, P. Achermann, and R. Huber. 2013.Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent performance improvement. Brain Stimulation 6:805–811.

Pakhomov, A. G., and M. R. Murphy. 2000. A comprehensive review of the research on biological effects of pulsed radiofrequency radiation in Russia and the former Soviet Union. In Electromagnetic Fields in Living Systems, Vol. 3, edited by J. C. Lin. New York: Kluwer Academic/Plenum Publishers. Pp. 265-290.

Pall, M. L. 2013. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. Journal of Cellular and Molecular Medicine 17(8):958-965.

Pall, M. L. 2016. Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. Journal of Chemical Neuroanatomy 75(Pt B):43- 51.

Ramundo-Orlando, A. 2010. Effects of millimeter waves radiation on cell membrane—a brief review. Journal of Infrared, Millimeter, and Terahertz Waves 31(12):1400-1411.

Salford, L. G., A. E. Brun, J. L. Eberhardt, L. Malmgren, and B. R. Persson. 2003. Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. Environmental Health Perspectives 111(7):881-883; discussion A408.

Stein, Y., and I. G. Udasin. 2020. Electromagnetic hypersensitivity (EHS, microwave syndrome)—review of mechanisms. Environmental Research 186:109445.

Steiner, U. E., and T. Ulrich. 1989. Magnetic field effects in chemical kinetics and related phenomena. Chemical Reviews 89(1):51-147.

Tan, S., H. Wang, X. Xu, L. Zhao, J. Zhang, J. Dong, B. Yao, H. Wang, H. Zhou, Y. Gao, and R. Peng. 2017. Study on dose-dependent, frequency-dependent, and accumulative effects of 1.5 GHz and 2.856 GHz microwave on cognitive functions in wistar rats. Scientific Reports 7(1):10781.

Zhao, T. Y., S. P. Zou, and P. E. Knapp. 2007. Exposure to cell phone radiation upregulates apoptosis genes in primary cultures of neurons and astrocytes. Neuroscience Letters 412(1):34-38.

7.4 Other well documented negative biological effects

There is also extensive evidence of other kinds of negative effects. We mention some particularly important references here.

We find an extensive reference list in a 90-page memo by Dr. Martin L. Pall:

> Ref. 306: Pall, Martin L: "5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them", memorandum dated 17.5.2018 sent to the European Commission, https://bit.ly/3YLV3gX*

Pall groups findings made in the 183 literature reviews he summarises, and identifies *eight groups of distinct adverse effects* in addition to *clearly identified therapeutic effects* – a total of nine groups. All nine are extremely well documented. He shows that there is broad agreement on these findings among independent researchers, so that the findings must be regarded as certain, i.e. solidly established and generally accepted within the academic community:

- Three different kinds of *DNA damage* in living cells. Supported by 21 different reviews.
- *Decreased fertility* in women and men, miscarriages, lower levels of sex hormones, decreased libido. Supported by 18 reviews.
- Damage to the *nervous system*, resulting in extensive neurological and neuropsychiatric effects. Supported by 25 reviews. These include sleep disorders/insomnia, fatigue/fatigue, headache, depressed mood/symptoms of depression, lack of concentration/attention/ cognitive disturbances, dizziness/vertigo, changes in memory, agitation/tension/anxiety/ stress/arousal, irritability.
- *Apoptosis* (programmed cell death), which can lead to neurodegenerative diseases, among other things. Supported by 13 reviews.
- *Oxidative stress and free radicals formation*, which is the basis of many different diseases. Supported by 19 reviews. Oxidative stress plays a role in all, or almost all, chronic diseases. Oxidative stress is reported to play significant roles in the mechanisms that maintain chronic diseases, in the attacks on cellular DNA, and may contribute to the creation of neurological effects. It creates *autoimmune disorders, chronic inflammations, fibromyalgia* and some of the mechanisms that can cause *cancer*.
- Extensive *hormonal disorders*. Supported by 12 reviews. Hormone levels can be both too high and too low compared to normal values. The levels of steroid hormones decrease with EMF exposure, while other hormone levels increase with the first exposure. Levels of the neuroendocrine hormones and insulin often decrease with prolonged EMF exposure, possibly due to *endocrine exhaustion*.
- *Increased amounts of calcium* in cells. This is one of the most central explanations for why weak, non-ionizing radiation can have such extensive effects on lived organisms. Supported by 15 reviews, as well as by research that has found positive effects in humans and by research that has looked at how insects use the Earth's electromagnetic field for navigation.

* or https://einarflydal.com/wp-content/uploads/2018/10/Pall-ML-5g-emf-hazards-eu-emf2018-6-11us3.pdf

- *Causation of cancer* of many different types. Supported by 35 different reviews, a number reflecting the many different cancers that EMF contributes to.
- *Therapeutic effects*, which means that specific types of EMF can be successfully used as a treatment. Pall cites 12 reviews, but states that one may find about 4,000 scientific papers on this topic.

In addition, Pall refers to a number of other literature reviews that find other effects, but which are not as extensively documented as the nine extremely well-proven effects.

Note that the material reviewed is *literature reviews* and not reports of individual findings (primary studies). Each of the literature reviews referred to in the lists above, cites from 5 to over 100 published primary studies. All of these primary sources show that exposure to non-thermal EMF leads to the effects listed.

From this it follows that behind the nine mapped groups of effects there is a massive primary literature that documents these effects thoroughly.

Pall also points out that there is a further set of literature reviews, 13 in this case, *all of which show that in most cases, pulsed EMFs are far more biologically active than non-pulsed EMFs*. *This point is particularly important since all wireless communication devices communicate via pulsation as a result of signal modulation* – the essential process by which content is conveyed by radio waves. Pulses are also created, as mentioned above, by digital equipment, motors, and digital converters and energy saving lamps (LED and fluorescent).

7.5 The effects have been known for many decades

In the following, we cite sources showing that negative effects of weak electromagnetic radiation have been known since the early 1800s.

A comprehensive historical review of the research on the effects of weak electromagnetic radiation has been carried out by the British expert organisation IGNIR:

IGNIR examined 2,000 research papers finding *biological effects* of weak electromagnetic radiation and sorted them as to the year the association between EMF exposure and the specific biological mechanisms and symptoms were first described and/or reliably proven and recognised. Literature references to all entries are found in the original document.

> Ref. 307: Bevington, Michael: Selected Studies On Electrosensitivity (ES) and Electromagnetic Hyper-Sensitivity (EHS), 4th edition (March 26th 2018) https://www.emfdata.org/download.php?field=filename_en&id=244&class=CUSTOM_Docu

As seen from the following summary (as by 2019), the vast majority of the effects have been known for many decades:

***SUMMARY*:** *Some key findings, with dates first described or established*	
Solar EM radiation variations: effects on plants	1801
Solar EM radiation variations: effects on humans	1860
Solar EM radiation variations: effects on insects	1881
Man-made electromagnetic fields: sensitivity effects on humans	1889
Non-thermal effects (20 kHz)	1896
Man-made electromagnetic fields: sensitivity in fish	1917
Electromagnetic Sensitivity, Electromagnetic Hyper-Sensitivity (EHS) in humans (RF)	1932
Blood: pearl chain/rouleaux formation	1946
Cataracts	1948
Brain tumours, leukaemia (microwaves)	1953
Solar and geomagnetic effects	1960
Microwave hearing, tinnitus	1961
Cardiovascular effects	1962
Microwave hearing, tinnitus	1962
Electromagnetic Sensitivity symptoms (ELF)	1966
Bone tumours	1968
Blood-brain barrier leakage	1974
Calcium flux	1974
Non-linear effects, ‘Windows’ effects	1977
Leukaemia, childhood (power lines)	1979
Depression, suicide	1979
Fetal damage (microwaves)	1981
Melatonin reduced	1981
Breast cancer, female (power lines)	1982
Skin cancer (microwaves)	1982
Leukaemia, adult	1982
Leukaemia, acute myeloid	1982
Cancer (microwaves)	1984
DNA synthesis, from time-varying magnetic fields	1984
Glutathione (antioxidant) reduced	1985
Amyotrophic lateral sclerosis (ALS), Motor Neuron Disease, a.k.a. Lou Gehrig’s disease	1986
Behavioural changes, from non-thermal static and time-varying magnetic fields	1986
Breast cancer (male)	1990

***SUMMARY*:** *Some key findings, with dates first described or established*	
Brain tumours, glioblastoma	1991
Calcium-dependent phosphorylation	1991
Mast cell degranulation	1994
DNA damage	1994
DNA damage	1995
Stochastic resonance, impacting voltage-dependent ion channels	1995
Grounding and earthing health effects	2000
EHS: ICD-10 “El-Allergy”; EHS: functional impairment (Sweden)	2000
Power frequency classified as 2B human carcinogen	2001
“Certain sensitive individuals” recognised by WHO/ICNIRP	2002
Magnesium-dependent phosphorylation in enzymes	2004
MAPK/ERK signal transduction path as signalling mechanism	2007
Alzheimer’s disease	2009
Brain tumours, glioma etc., from mobile phones	2009
Radio frequency classified as 2B human carcinogen	2011
Magnetic field effects on enzymatic synthesis by magnesium nuclear spin, published	2012
Safety levels for children (Bioinitiative, 2012)	2012
VGCCs mechanism, accepted	2013
Genetic variants associated with EHS	2014
Oxidative stress mechanism, accepted	2015
Objective tests for diagnosing EHS	2015
Tumour promotion	2015
Safety levels for sensitive people (EUROPAEM 2016)	2016
Primary cilia sensitivity	2017
3D fMRI scans show brain differences in people with EHS	2017
Autoimmune disease affected by electrosmog; Vitamin-D receptors	2017
Large study confirming RF (mobile phones) as a carcinogen (Hardell L et al)	2018
Large study confirming RF (mobile phones) as a carcinogen (Falcioni L et al)	2018

7.6 Effects that have been thoroughly demonstrated

From the previous paragraphs, we can conclude that the following effects are to be regarded as thoroughly demonstrated to be caused by weak – i.e. non-thermal – electromagnetic radiation – without the creation of any hazard from heating – not excluding other causations from being sources of these same symptoms too, nor excluding other possible symptoms:

Sleep disorders / insomnia,

tinnitus / ringing of the ears,

exhaustion / fatigue,

headache,

depressed mood / symptoms of depression,

lack of concentration / attention / cognitive disturbances / dizziness / vertigo,

changes in memory,

agitation / tension / anxiety / stress / arousal,

irritability,

neurodegenerative diseases,

autoimmune disorders,

chronic inflammations,

fibromyalgia,

hormonal disorders and

cancer.

These symptoms are found over and over in this book. And we find them again in the little data collection we've done, presented in the following section.

7.7 A survey compared to clearly demonstrated health effects

Here we present information we have collected from the plaintiffs in a court case concerning smart meters. The findings are compared with the symptoms we have seen recur as effects of EMF exposure.

In Figure 81 we have collected information about symptoms from a small number of plaintiffs in connection with a court case concerning smart meters. We made no medical assessment of the individuals, but asked them to report their own symptoms. The questionnaires were anonymised and the analysis was conducted without any knowledge as to their names or identities. Some of the symptoms they report are diseases/injuries for which they are treated by the health service and are thus diagnosed by a doctor.

As the table shows, there is considerable agreement between symptoms reported in the embassy report and occurrences in this group of plaintiffs. The pattern also coincides with the above-listed effects of man-made electromagnetic radiation.

It is therefore reasonable to assume that these symptoms, especially when seen in context, may be caused by man-made electromagnetic radiation or may be exacerbated by such exposure.

Respondent no:	4	5	6	7	9	10	12	14	15
Found in the USA Report as well as among the plaintiffs:									
Pressure and vibration			x	x	x				
Tinnitus/ringing in the ears	x	x	x		x	x	x		x
Ear pain									
Hearing loss		x							
Dizziness					x				
Visual disturbances			x		x	x	x		
Exhaustion/ME				x	x		x		
Headache	x		x		x	x	x		
Migraine	x				x	x			
Impaired concentration					x	x	x		
Insomnia		x	x	x	x	x	x	x	
Other symptoms among the plaintiffs:									
Blood pressure problems	x				x		x		x
Muscle and joint pain			x	x	x		x	x	x
Heart rhythm disturbances				x	x	x			
Anxiety			x	x					
Metabolic problems				x			x	x	
Autoimmune reactions*				x	x		x	x	
Fibromyalgia				x					
Inflammation							x	x	
Temperature control**					x		x		
Frequently found, though not scientifically proven to be connected to EMF exposure:									
Itching and tingling of the skin	x				x	x	x		
Acute heat	x				x	x	x		
Eye pain							x	x	

Figure 81:Table of symptoms found among plaintiffs in a court case concerning smart meters
** Autoimmune reactions include allergies, asthma, COPD, eczema, etc.*
*** Temperature control includes unstable temperature and low fever.*

Furthermore, the embassy report points out that it is to be expected that electromagnetic radiation can exacerbate any health problems already present from other causes, a so-called *interaction effect*. It might be relevant here, but we have no basis for any having any opinion on that matter.

Respondents 6, 9 and 12 also reported experiencing symptoms akin to having *blind tests*, i.e. situations where they surprisingly have developed acute symptoms and become very ill after exposure to microwave radiation that they had no knowledge of or could not foresee. Several among them reported *acute reactions* to, among other things, mobile phones and WiFi routers, leading them to avoiding any use of such devices, or even of staying in their neighbourhood.

7.8 The findings are consistent with the present state of knowledge

In this book, we have shown that, in principle, as to the effects on the electric field it is of no importance whether the radiation stems from wireless radio communication or from some equipment attached to the electrical wiring. The effects from the electric field are just the same. We have also explained that low frequency pulsing is central to the biophysical effects of exposure to so-called "weak non-ionizing radiation".

We can therefore assume that the many reported experiences of how the removal of transmitters of radio frequency radiation or shielding against such fields lead to a positive effect on health, are valid. And we can assume that removal, shielding or filtering of dirty electricity will also have positive effects. For an example, see

> Ref. 308: Redmayne M, Johansson O., Could myelin damage from radio frequency electromagnetic field exposure help explain the functional impairment electro-hypersensitivity? A review of the evidence. Toxicol Environ Health B Crit Rev. 2014;17(5):247-58. doi: 10.1080/10937404.2014.923356, https://bit.ly/3UhhaKl*

We also know from experience with hypersensitivity that once people have become hypersensitive through overexposure, many will stay so for the rest of their lives and few will be able to get rid of it.

There have been no systematic measurements or mapping done of radiation from AMS installations in Norway, nor of dirty electricity or of how residents fare when the exposure source is removed. However, there are user experiences that show acute health problems from smart meters after installation, even in blinded situations, as well as reports that health problems that appeared when smart meters were installed, disappeared or were mitigated when meters were removed. For a collection of self-reports from Norway, with several such cases, see:

> Ref. 309: Smart meter self-reports, https://bit.ly/3jhPSp0†

The symptoms found when reading these self-reports are immediately identifiable among the symptoms presented here in the book.

7.9 Sources containing more detailed evidence

Here is a quick review of our evidence to substantiate that effects of exposure to weak electromagnetic radiation from wireless communication and dirty electricity are real and cannot reasonably be explained as manifestations of placebo/nocebo effects.

We have provided detailed evidence that both intensity and several other properties of the electromagnetic fields around power lines have a biological impact. Furthermore, we have seen that these effects can have very varying effects in the form of symptoms/reactions – quite acutely or only after some time, or only after a long time – and that these reactions may be serious enough to be characterised as significant health problems and/or damage.

Among other things, we have referred to Russian research, which already since the 1960s maintained that abrupt, sharp pulses like in real microwave communication, have significant health effects. For a short reference list of scientific papers see:

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* Full link: https://www.researchgate.net/publication/265515794_Could_Myelin_Damage_From_Radiofrequency_Electromagnetic_Field_Exposure_Help_Explain_the_Functional_Impairment_Electrohypersensitivity_A_Review_of_the_Evidence/link/5ac6b0ae0f7e9bcd5193205c/download

† (Norwegian) Original title: Smartmåler-historier. Full link: https://einarflydal.com/smartmaler-historier/

Ref. 310: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, 2018, https://bit.ly/3BI97h3* Part 2, Section 4.2.5

We have also seen that many have warned of significant biological health effects and serious public health consequences (e.g. Martin L Pall, see Ref. 306).

The large EU project REFLEX, which looked at pulsed radiation in laboratory tests on cell cultures, also concluded that there were clear and harmful effects over time on cells from pulsed exposure to weak microwaves.

Ref. 311: Adlkofer, Franz & al: Risk Evaluation of Potential Environmental Hazards From Low Frequency Electromagnetic Field Exposure Using Sensitive in vitro Methods, Final report REFLEX Study, 31 May 2004, https://bit.ly/3n2q41F†

The mechanisms behind EMF impacts are in part well known, in part only hypothesized or theoretically treated, in part unknown but assumed, in part completely unknown. The effects have nevertheless been observed in a large number of studies, reports, notes or other formats and more or less specialized on particular causations.

For example, (Behrstecker 2020) has compiled a substantial list of research references – from the early 1990s onwards – demonstrating the *influence on epiphysis hormone production* from weak man-made electromagnetic exposure:

Ref. 312: Pineal Gland – References & Studies from the early 90s, bibliography compiled by Michael Behrstecker, undated, https://bit.ly/3JQr1my‡

Effects on the biology of *nature's pulse characteristics* have been shown to be extensive. The complexity of biological processes allows for a particularly large number of possible effects that can occur via several mechanisms. (Pockett 2020, Part III) provides a number of explanations and physical calculations – for example, on the impact of radiation from cell towers, on the impacts on cell membranes and down to impacts on hydrogen bonds in water molecules. The calculations support empirical findings that such exposure can easily cause harm to human and environmental health:

Ref. 313: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW§

Pockett emphasises that newer radio techniques use ever more abrupt and sharp pulses. So do electronic power supplies and converters (SMPS) which are widely used in energy saving bulbs etc. In practice, based on these authors' experiences and reports from EHS people, this seems to aggravate health problems.

New health problems arising from fluorescent lamps and modern electronics based on SMPS were extensively documented as a “by-product”, or collateral damage, from the introduction of *office computer equipment* during the years of *office automation* in the 1970s and 80s. This created a number of new EHS people, by the thousands just in Sweden, as well as in other countries:

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* Full link: https://einarflydal.com/sdm_downloads/download-smart-meters-the-law-and-health-pdf/

† Full link: https://pandora-foundation.eu/2009/06/01/reflex-study-final-report/

‡ Full link: https://www.mberstecher.de/references-pineal-gland.pdf

§ https://www.safertechnology.co.nz/wp-content/uploads/2021/04/ELECTROSMOG-May-2021.pdf
We relate to the Norwegian edition: Susan Pockett: Stråletåka – Helse - og miljøforurensningen fra mikrobølgene, 237 pages, Z-forlag, 2020, ISBN 978-82-93187-50-9.

Ref. 314: Granlund-Lind, Rigmor & Lind, John: Black on White. Voices and Witnesses about Electro-hypersensitivity. The Swedish experience, 2005, https://bit.ly/3lnot6d*

Others point out that man-made EMF pulses approach ever more the characteristics of nature's own pulses, which all biological life is adapted to and takes advantage of. Among those who explored such pulses were the German laboratory engineer Hans Baumer and medical meteorologist Walter Sönning. They identified a systematic relationship between weather fronts of different kinds and specific polarised, coherent electrical pulses, *CD-Sferics a. B. (after Baumer),* from weather systems discharges on the one hand, and the twisting of collagen molecules, and thus on metabolism, neurological conditions and epileptic seizures, on the other:

Ref. 315: Baumer, Hans: Sferics – The discovery of weather radiation, Rowohlt, 1987, ISBN 3498004875†

As of spring 2023, the recently published extensive literature review, mentioned previously (as Ref. 216b), seems to provide a new milestone in the strivings for solid documentation of the health and environmental impact from non-thermal man-made EMF's.

Ref. 315b: Panagopoulos DJ (Ed.). (Dec 30, 2022). Electromagnetic Fields of Wireless Communications: Biological and Health Effects (1st ed.). CRC Press. DOI: 10.1201/9781003201052, https://bit.ly/3KA22ol‡)

The documentation above confirms that the effects of exposure to sub-thermal radiation and dirty electricity are factual. The reactions to EMF exposure cannot reasonably be explained as manifestations of placebo/nocebo effects.

* English edition of Swedish book. Full link: https://www.quwave.com/blackonwhite-swedish-electrosensitivity-study.pdf

† German. Original title: Sferics. Die Entdeckung der Wetterstrahlung.

‡ Full link: https://www.routledge.com/Electromagnetic-Fields-of-Wireless-Communications-Biological-and-Health/Panagopoulos/p/book/9781032061757

8. When governments fail, each individual must be allowed to protect themselves

This book has put forward solid amounts of evidence showing it is not scientifically justifiable to base radiation protection on the *thermal paradigm* – that only radiation that is intense enough to cause heating has been proven to produce health damage. Evidence has been presented in the form of peer-reviewed scientific publications, as well as the minutes of witness statements by experienced scientists and professionals as well as by laypeople who, without premonition, have been affected by health damage from exposure, and who fear that they themselves or their neighbours will be.

We have demonstrated that the basic knowledge of this threat to health has been present for decades, but has been systematically pushed aside by stakeholders for a variety of reasons.

As evidence more precisely related to AMS meters and dirty electricity, we have also presented a substantial body of knowledge in the form of peer-reviewed scientific publications as well as newspaper articles and minutes of testimony from experienced professionals made in trials conducted in the United States, including testimonies from several of our planet's foremost scientists and veterans within this area.

It is an expressed political ideal in many countries – including Norway – that society should be governed on the basis of the best available knowledge.

This book has put forward such evidence – in fact of the two strongest kinds in the “hierarchy of evidence” established by the science theorist Karl Popper – demonstrating that such management is not the case within the field of radiation protection, and that almost the entire population is affected – some acutely and critically – if not from other sources, then by the introduction of AMS meters.

The researchers cited, and many others mentioned, emphasise in particular the harmful biological health effects of pulsed radiation, whether coming from radio transmitters in the form of microwave communications or from the mains in the form of dirty electricity.

We have also shown that there exist several court rulings where the plaintiff has won, among them cases involving French smart meters' production of dirty electricity creating health problems for EHS people. Hence, we see that experts as well as some courts do not accept to be guided by exposure limits set by processes where knowledge is not given the decisive word, but is swept aside to create the greatest possible room for manoeuvre.

We have here and elsewhere documented that to uphold this room for manoeuvre, which originally was established for strategic reasons and politically sanctioned, an industry strategy game is still being played.

In this book, we have only just touched on questions such as how electro-hypersensitivity – EHS – comes about, and how such hypersensitivity can be defined or explained biophysically. We have wanted to limit the scope and have therefore refrained from presenting a lot of material that could further elaborate on this. Nor do we consider it important in this context. Interested readers are hereby referred to this comprehensive knowledge review:

> Ref. 316: Bevington, Michael: Selected Studies On Electrosensitivity (ES) and Electromagnetic Hyper-Sensitivity (EHS), 4th edition (March 26th 2018), https://bit.ly/42qZhMA*

* Full link: http://www.es-uk.info/wp-content/uploads/2018/05/Selected%20ES%20and%20EHS%20studies.pdf

Whatever one chooses to call the phenomenon, the observed reactions to exposure are there and easily observable. They have had many names throughout history as we have shown. We have also shown that it is in line with the best of available science to consider these reactions induced by electric, magnetic and/or electromagnetic fields from individuals' exposure to electromagnetic fields. Different individuals react to fields of different characteristics – some acutely, some only after a substantial amount of time, some never do. Probably quite a few struggle with health problems from EMF without understanding what the cause might be.

Nor have we presented detailed measurements of electromagnetic fields in homes. Such measurements, as well as the interpretation of them, have to be carried out and interpreted for the each individual case, based, among other things, on the knowledge contained in this book.

8.1 Time to Get Rid of This Cold War Relic?

Norwegian radiation protection policy, as well as similar radiation protection policies in many other countries, follow a tradition of radiation protection that has not changed since the 50s and 60s, when there was Cold War and the general population was only exposed to relatively little broadcasting and analogue electricity consumption at home. Only in certain areas close to military radar and radio systems, as well as in certain kinds of jobs would exposure be substantial.

The most exposed were radar and radio repairmen. Exposure restrictions were set so as not to make them acutely ill when they repaired or operated technical equipment. However, it has been known since then that people became sick from weak electromagnetic radiation, then named "radar man's disease" and "radio man's disease". The symptoms these people experienced were, and still are amongst radio amateurs, in line with today's known symptoms from exposure to "weak", i.e. non-thermal, electromagnetic radiation.

The health risk from such exposure is, as we have seen, recognised to a far greater extent in many other countries, such as China, India, Russia, Italy, Switzerland and the former Soviet dominated states of Eastern Europe. The basis for more restrictive policies is the extensive and systematic research that was carried out both in the East and in the West. These countries simply took more care, and therefore have far lower exposure limits, in some cases very much lower, and recognise health-related reactions as results from exceeding them.

This schism between the East and the West has been up for debate for several decades, with several attempts to bridge it. In 1999, a meeting was held between people from Russian radiation protection authorities and the ICNIRP and WHO where harmonization of exposure limits between East and West was discussed. The two different views on the dangers of electromagnetic radiation became clearly visible:

> Ref. 317: Microwave News November/December1999: "Standards Harmonization Meeting: Russia and West Far Apart", https://bit.ly/42r0BPy*:
>
> "East met West in September at a conference in Moscow on radiation safety—but neither side so much as blinked.
>
> Russia's limits for exposure to radio frequency and microwave radiation (RF/MW) are up to 100 times stricter than those found in the US and Western Europe.
>
> Despite extensive discussions and toasting of vodka at the Moscow Conference, there was no compromise in sight. It seems that the chasm that has separated the two sides for over 30 years will remain the same for some time to come.

* Full link: https://microwavenews.com/news/backissues/n-d99issue.pdf

...

> Western standardization organizations have emphasized protecting against RF/MW thermal effects, Grigoriev said, while Russia's more restrictive standard also reflects a concern over non-thermal effects and subjective symptoms.
>
> …
>
> The two sides will not reach common ground for some time. Dr. Jürgen Bernhardt, of Germany's Federal Office of Radiation Protection and the chair of ICNIRP, predicted that it will take "at least another three to four years to achieve harmonization of the standards."

This was in 1999. It seems radiation protection in the West and the East is still challenged by that same chasm.

The setting of exposure limits is a political decision and the primary task of the radiation protection agencies should be to provide a correct picture of the risk of health effects from various potential or real radiation regimes. We have seen that this is clearly not what happens today, and we can only speculate on what the causes might be. However, it seems obvious that since the days of the Cold War, other players have come to the fore with their interests in maintaining lax limits.

8.2 Radiation protection deficiencies and consequences for customers and the electricity industry

Finally, there may be reason to summarise what seems to be missing with the Norwegian radiation protection regime and what the consequences are for customers of electricity network companies in Norway and probably in several other countries:

Not only consumers, but also the electricity grid companies and public administration are among the injured – as well as those who work there.

This book is mainly about the right to choose which health risk to take when at home. Shouldn't residents be allowed to have control over the radiation exposure levels in their own home? And to which degree is it acceptable to expose the electricity customers to dirty electricity as a precondition for them to be connected to the electrical grid?

The topic could easily be extended to workplaces: As of date, there is no exemption whatsoever for the installation of smart meters in workplaces in Norway. Should grid companies have the right to install technical equipment that pollutes the workplace where the customers themselves and their employees stay much of the day, with an environmental toxin that has been clearly proven in research for many years to put living creatures, including humans, under biological stress, inflicting health and environmental problems on them or increasing the risk of so, acute as well as over time?

In a welfare society, we are dependent on having strong and legitimate actors in the infrastructure and basic welfare businesses, such as electricity, communication and health services. Legitimacy can only be upheld by providing consumers with correct and factual information, and not allowing themselves to be used in a game of hiding information, or even running such games themselves.

As consumers, workers and private individuals, we have to live with the consequences of these public or private bodies' actions.

Therefore, we must also keep a critical eye at them, always suspecting they are failing in their role in society: Not only market players may fail, but so may also the governmental bodies set to promote the interests of society in their sector by regulations. Also, we should confront politicians

leaving the setting of exposure limits to an administrative apparatus that acts neither precautionary nor knowledge-based.

This situation has been warned about for several years. Now it is time to find solutions, both for smart meters and for other devices from which we see the evidence of harmful effects. That responsibility cannot only, nor primarily, lie with the individual, but must lie with the electricity network companies, the governmental bodies such as for electricity, radiation protection, the health sector and the environment, as well as with politicians, who in the end are the ones in charge.

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Bibliography

Ref. 1: Smart meter self-reports, https://bit.ly/3jhPSp0....18

Ref. 2: The Biological Effects Of Electromagnetic Radiation (Microwaves), presentation at the Australian Radiation Protection And Nuclear Safety Agency (ARPANSA) ElectroMagnetic Energy Reference Group (EMERG), November 2015, DOI: 10.13140/RG.2.2.28585.47205, foil no. 54....19

Ref. 3: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3....20

Ref. 4: (Norwegian) Product Control Act....21

Ref. 5: (Norwegian) Product Liability Act....21

Ref. 6: (Norwegian) Act on radiation protection and the use of radiation....22

Ref. 7: (Norwegian) Regulations on radiation protection and the use of radiation (the radiation protection regulations)...22

Ref. 8: (Norwegian) Regulations on general permits for the use of frequencies (“The free use regulation”)....22

Ref. 9: ICNIRP, 2020. Guidelines for limiting exposure to electro-magnetic fields (100 kHz to 300 GHz), published ahead of print in: Health Physics, April 2020....23

Ref. 10: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012....23

Ref. 11: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, 590 pages (Norwegian)....24

Ref. 12: Butler, Tom: Wireless Technologies and the Risk of Adverse Health Effects in Society: A Retrospective Ethical Risk Analysis of Health and Safety Guidelines, Working Paper, Univ. of Cork, 2021, PDF note, https://bit.ly/3WpO9MM....25

Ref. 13: Arthur Firstenberg, The Invisible Rainbow – A History of Electricity and Life, AGB Press, 2017....25

Ref. 14: ORSAA – ICNIRP submissions Oct 1918, ORSAA, https://www.orsaa.org/icnirp-submission.html....25

Ref. 15: Lai, H; Singh, N. P. (1995). “Acute low-intensity microwave exposure increases DNA single-strand breaks in rat braincells” (PDF). Bioelectromagnetics. 16 (3): 207–10. ISSN 0197-8462. PMID 7677797....25

Ref. 16: Henry Lai's Research Summaries, nine documents posted on http://www.bioinitiative.org/research-summaries/, December 2017....26

Ref. 17: Powerwatch, http://www.powerwatch.org.uk/....26

Ref. 18: Joel M. Moskowitz, Joel: PowerWatch: 1,670 Scientific Papers on Electromagnetic Fields, May 1, 2019, http://bit.ly/PowerWatch1670....26

Ref. 19: EMF-Portal, https://www.emf-portal.org/....26

Ref. 20: ICNIRP, 1998. “ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic And Electromagnetic Fields (UP To 300 GHz)”, Health Physics 74 (4):494-522; 1998, https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf....27

Ref. 21: ICNIRP, 2020. Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), published ahead of print in: Health Phys, March 2020, https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf...27

Ref. 22: Presman, A. S., 1970. “Electromagnetic Fields and Life”, English edition: Springer science+business media LLC, New York, 1970, ISBN 978-1-4757-0637-6, https://bit.ly/3vJIRA8....27

Ref. 23: Pall, Martin L: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, note dated 17.5.2018, https://bit.ly/3YLV3gX....28

Ref. 24: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019 (Norwegian), page 178:....28

Ref. 25: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW, see especially Chapters 2, 3 and 4....29

Ref. 26: Else Nordhagen and Einar Flydal: The Norwegian Radiation Protection Authority claims the radiation does not harm. Why?, (Norwegian) blogpost 04.02.2021....29

Ref. 27: Conway, Erik M. and Oreskes, Naomi: Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, Bloomsbury Press, 2010.....29

Ref. 28: Michaels, David, Doubt is their product, Oxford University Press, 2008, ISBN 0199719764, see e.g. ch. 14: The Institutionalization of Uncertainty, p. 176 etc.....30

Ref. 29: Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y., 2017.....30

Ref. 30: Wright, Nicola: "Downplaying Radiation Risk", Chapter 23 in Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y., 2017.....30

Ref. 31: Alster, Norm: Captured Agency, How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates, Edmond J. Safra Center for Ethics, Harvard University, 2015, https://bit.ly/3Co7NR6 30

Ref. 32: Stein, Brian & Mantle, Jonathan: The Microwave Delusion, Grosvenor House Publishing, 2020.....31

Ref. 33: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, see especially Part 3. For full ref, see Ref. 11.....31

Ref. 34: Paul Brodeur: The Zapping of America, N.Y. 1977, ISBN: 978-0393064278.....31

Ref. 35: Adams, Ronald L, Williams, R.A.: Biological Effects of Electromagnetic Radiation (Radiowaves and Microwaves) Eurasian Communist countries (U), US Defense Intelligence Agency, 1975, https://bit.ly/3ZeeY8h.....31

Ref. 36: Marino, Andrew: Going somewhere – Truth about a life in science, Cassandra Publishing, 2010.....32

Ref. 37: Marino, Andrew, Ray, Joel: The Electrical wilderness, San Francisco Press, 1986.....32

Ref. 38: Electromagnetic fields and health, Proposal for a management strategy, NOU 1995:20, a Report from a cross-ministerial official group submitted to the Ministry of Social Affairs and Health, Norway, 1995.....32

Ref. 39: Bandara, P., and Carpenter, D. O. 2018. "Planetary electromagnetic pollution: it is time to assess its impact", The Lancet, vol.2:12, e512-e514, https://bit.ly/2LnZXLV.....32

Ref. 40: Two brochures from the Norwegian RPA (DSA) on "non-ionizing" radiation protection, May 2020, https://bit.ly/3CrKdDg.....34

Ref. 41: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, see especially Part 3. For full ref, see Ref. 11.....34

Ref. 42: Bård-Rune Martinsen "The Norwegian Radiation Protection Authority is active in directly illegal and misleading marketing", 2019.....35

Ref. 43: "Lawyer firm top Hugo Matre sent a letter critical as to radiation – without saying who the clients were", *Dagens Næringsliv*, 16 January 2021, https://bit.ly/3vnafDD.....36

Ref. 44: Buchner, K. and Rivasi, M. (2020) The International Commission on Non-Ionizing Radiation Protection: Conflicts of interest, corporate capture and the push for 5G. A Report by Members of the European Parliament, Michèle Rivasi (Europe Écologie) and Dr. Klaus Buchner (Ökologisch-Demokratische Partei), June, 2020, 1-98. https://bit.ly/3ZeonNf.....37

Ref. 45: Impacts of 5G wireless communications on human health, Briefing to the European Parliament on 5G from the European Parliamentary Research Service, PE 646.172 NO February 2020, https://bit.ly/3CtWLKt.....37

Ref. 46: "How much is safe?", Investigate Europe, 4 January 2019, https://www.investigate-europe.eu/en/2019/how-much-is-safe/.....37

Ref. 47: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, see especially Part 3. (For full ref, see Ref. 11.).....37

Ref. 47b: Added 2023 - Nordhagen EK, Flydal E. Self-referencing authorships behind the ICNIRP 2020 radiation protection guidelines. Rev Environ Health. 2022 Jun 27. doi: 10.1515/reveh-2022-0037. Epub ahead of print. PMID: 35751553, https://bit.ly/3CvHOY9.....37

Ref. 48: Horsevad, Kim, Kortlægging, Mapping Bioreactivity for Microwaves in Non-thermal Intensities, Saxo Publishing, 2017, ISBN 9788740912418.....38

Ref. 49: Panagopoulos, Dimitris, 2019. "Comparing DNA Damage Induced by Mobile Telephony and Other Types of Man-Made Electromagnetic Fields", Mutation Research/Reviews in Mutation Research. 781. 10.1016/j.mrrev.2019.03.003.....38

Ref. 50: Milham, Samuel: Dirty Electricity – Electrification and the Diseases of Civilization, iUniverse, 2012, ISBN 978-1938908187, pp. 55 ff....39

Ref. 51: Samuel Milham and L. Lloyd Morgan: A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School, https://www.stetzerelectric.com/wp-content/uploads/Milham-Morgan-2008.pdf....39

Ref. 52: Literature list on dirty electricity (Norwegian and non-Norwegian literature), https://bit.ly/3VKGU0M....39

Ref. 53: Wulfsberg, Terje, "Påvirkes helsen din av skitten strøm?" ("Is your health affected by dirty electricity?") 1.5.2016, Nyhetsspeilet, https://www.nyhetsspeilet.no/2016/05/pavirkes-helsen-din-av-skitten-strom/....39

Ref. 54: The EMSafety project (2011-2014), https://www.sintef.no/projectweb/em-safety/....40

Ref. 55: Overview of Scientific Assessments of Research on ELF EMF and Health and Epidemiologic Studies, 2007-2015, Exponent, 149 Commonwealth Drive, Menlo Park, California 94025, September 8, 2015, https://bit.ly/3WIHgpE....40

Ref. 56: Electromagnetic fields and health, Proposal for a management strategy, NOU 1995: 20, https://www.regjeringen.no/no/dokumenter/nou-1995-20/id140410/....41

Ref. 57: Karl Riley: Tracing EMFs in Building Wiring and Grounding, third edition, revised, 2012, ISBN: 1-4699-0201-X, p. 4....41

Ref. 58: Static and Extremely Low-Frequency Electric and Magnetic Fields, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, (Vol. 80) (19-26 June 2001)....42

Ref. 59: Arnt Inge Vistnes: "Electromagnetics at home" in Brune D, et al.: Radiation at Home, Outdoors and in the Workplace, Scandinavian Science Publisher, 2001, Chapter 19.10 Exploration of exposure, https://bit.ly/3FpJwce....42

Ref. 60: Arthur Firstenberg, 2017. The Invisible Rainbow – A History of Electricity and Life, AGB Press, Chapters 11, 12, 13, 14....42

Ref. 61: Martin L. Pall: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, PDF note, see Chapter 6: The Great Risks of 5G: What We Know and What We Don't Know. https://bit.ly/3jzi86x, (republished in Norwegian and some other languages)....42

Ref. 62: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW See Chapter 15 Membranes....42

Ref. 63: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, pp. 131-134, or from p. 34 in https://bit.ly/3PYwo4U For full ref, see Ref. 11....43

Ref. 64: William J. Sutherland, Stuart H.M. Butchart, Ben Connor, Caroline Culshaw, Lynn V. Dicks, Jason Dinsdale, Helen Doran, Abigail C. Entwistle, Erica Fleishman, David W. Gibbons, Zhigang Jiang, Brandon Keim, Xavier Le Roux, Fiona A. Lickorish, Paul Markillie, Kathryn A. Monk, Diana Mortimer, James W. Pearce- Higgins, Lloyd S. Peck, Jules Pretty, Colleen L. Seymour, Mark D. Spalding, Femke H. Tonneijck, and Rosalind A. Gleave: A 2018 Horizon Scan of Emerging Issues for Global Conservation and Biological Diversity, Trends in Ecology & Evolution, January 2018, Vol. 33, No. 1 https://doi.org/10.1016/j.tree.2017.11.006....43

Ref. 65: Hecht, K.; H.-U. Balzer (1997): Biologische Wirkungen elektromagnetischer Felder im Frequenzbereich 0 bis 3 GHz auf den Menschen. (Biological effects of electromagnetic fields in the frequency range 0 to 3 GHz on humans.) Commissioned by the Bundesinstitut für Telekommunikation. Contract no. 4231/630402....44

Ref. 66: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3 Part 2, Section 13....44

Ref. 67: Arthur Firstenberg, 2017. The Invisible Rainbow – A History of Electricity and Life, AGB Press (translated into Norwegian 2018), especially Chapters 1 and 2....44

Ref. 68: Excerpt from "Electromagnetic hypersensitivity means Peter Lloyd can't leave his house... or enjoy any modern pleasures inside" by Martin Shipton, Wales Online, Oct 16, 2014, updated March 2022, shortlink https://bit.ly/3hOpZN3....45

Ref. 69: Test of electrically hypersensitive, Danmarks Radio, shortlink; https://youtu.be/_xeWmi9M1_M....45

Ref. 70: Rea, William & al, Electromagnetic Field Sensitivity, Journal of Bioelectricity, 10 (1&2), 241-256, 1991, https://bit.ly/3Cz60sQ....45

Ref. 71: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012.....46

Ref. 72: Oftedal, Gunnhild: “Electro-hypersensitivity – investigation into causes and possible measures and treatment plans”, Report (Norwegian), Sør-Trøndelag University college, Department of Technology, 2006, https://bit.ly/3CD7L8g.....46

Ref. 73: Schmiedchen, K., Driessen, S. & Oftedal, G. Methodological limitations in experimental studies on symptom development in individuals with idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF) – a systematic review. Environ Health 18, 88 (2019). https://doi.org/10.1186/s12940-019-0519-x.....46

Ref. 74: Rubin, GJ, Hillert, L, Nieto-Hernandez, R, van Rongen, E, Oftedal, G: Do People With Idiopathic Environmental Intolerance Attributed to Electromagnetic Fields Display Physiological Effects When Exposed to Electromagnetic Fields? A Systematic Review of Provocation Studies, Wiley, 2011.....46

Ref. 75: Stein, Brian & Mantle, Jonathan: The Microwave Delusion, Grosvenor House Publishing, 2020, pp. 35-39.....47

Ref. 76: Opinion of the European Economic and Social Committee on 'Electromagnetic hypersensitivity', (own-initiative opinion), (2015/C 242/05), https://bit.ly/3FQBVWo.....47

Ref. 76b: Granlund-Lind, Rigmor & Lind, John: Black on White. Voices and Witnesses about Electrohypersensitivity. The Swedish experience, 2005, https://bit.ly/3YUO5X2.....47

Ref. 77: Improved electrical environment in new construction – Furiren 3 in Kristianstad. (PDF) The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-497-8. 36 pages.....47

Ref. 78: (PDF) The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-481-1, 34 pages. 47

Ref. 79: Improved electrical environment – measures to reduce electrical and magnetic fields fields in housing) (PDF, approx. 6 MB). The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-503-6. 44 pages.....48

Ref. 80: Extensive sanitation – Measures to reduce electrical and magnetic fields in homes. (PDF) The Swedish National Board of Housing, Building and Planning, 1998, ISBN 91-7147-508-7. 40 pages.....48

Ref. 81: WHO Work Group Meeting Report of WHO workshop on electro-hypersensitivity 25-27 October 2004, Prague, Czech Republic. 2005, https://bit.ly/3VvyiuN.....48

Ref. 82: Hecht, K. “Health Implications of Long-term Exposure to Electrosmog”, Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V. 2016, https://bit.ly/3IzdNut.....49

Ref. 83: Medically Unexplained Ailments and Symptoms (MUPS), The Norwegian Medical Association's sub-committee for MUPS, https://bit.ly/3jVAE94.....50

Ref. 84: Rune Skogheim: “The Song of Sinking Hearts”, interview, Journal of the Norwegian Medical Association, https://bit.ly/3Znt3QV.....51

Ref. 85: Wolfgang Huber and Volker von Baehr: Chronic systemic inflammatory diseases – A standardized diagnostic method leads to targeted therapy, (German), Umwelt·Medizin·Gesellschaft, (a journal for environmental medicine), 27, 4/2014, p. 271 et seq., https://bit.ly/3YTHImI.....52

Ref. 86: Pall M. L. 2007 Explaining 'Unexplained Illness': Disease Paradigm for Chronic Fatigue Syndrome, Multiple Chemical Sensitivity, Fibromyalgia, Post-Traumatic Stress Disorder, Gulf War Syndrome and Others, Harrington Park (Haworth) Press.....52

Ref. 87: Pall ML. 2013 Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J Cell Mol Med 17:958-965.....53

Ref. 88: Claude Monnet and Pierre le Ruz: The Microwave Syndrome, undated “factsheet”, https://bit.ly/3wbLcEd.....53

Ref. 89: Beety, Nina: Overview: Fire and Electrical Hazards from 'Smart', Wireless, PLC, and Digital Utility Meters, paper, July, 2019, page 25, https://bit.ly/3WL2za0:.....54

Ref. 90: Helmut Breunig: Tree damage caused by mobile phone base stations – An observation guide, March 2017, English version from German original: https://bit.ly/3C7dPp4.....55

Ref. 91: Carpenter, David et al.: “Correcting the Gross Misinformation”, La Maison du 21e siecle, June 17, 2012, https://bit.ly/3Vovvna.....55

Ref. 91b: Carpenter, David Testimony before the Michigan Public Service Commission, https://sforce.co/3hViTX1.....55

Ref. 92: Carpenter, David, Hardell, Lennart, Havas, Magda, Herbert, Martha and Milham, Sam: Subject: Docket Number E-7 Sub 1115- Smart Meter Opt-Out Fees, Letter to the North Carolina Utilities Commission, August 2, 2016, (page 1, *our emphasis*), https://bit.ly/3Wtx4BG.....55

Ref. 93: Carpenter, David: Testimony on Smartmeters for Michigan Public Service Commission by Dr. David Carpenter May 22 2015, Before The Michigan Public Service Commission, with attachments, (page 3 onwards), https://bit.ly/3FYwWTD....56

Ref. 94: Conrad, Richard H., Ph.D. Biochemist: Nine Reasons Why Today's Smart Meter Systems are a Mistake, by, May 9, 2014, https://bit.ly/3YWmiFx....57

Ref. 95: Conrad, Richard H., Ph.D.: For Legislators on Wireless Smart Meters: HEALTH and SAFETY ISSUES, May 12, 2014, https://bit.ly/3FTBg6o....58

Ref. 96: Conrad, Richard H, Dr.: Maine Public Utilities Commission Testimony on Smart Meters. 2013, https://bit.ly/3I3DPWq....59

Ref. 97: Conrad, Richard, PhD and Friedman, Ed: Smart Meter Health Effects Survey: Results, Analysis and Report, 2013, presented to the Maine PUC in their proceedings to determine the safety of smart meters: or https://bit.ly/3VtFSWL....59

Ref. 98: Halteman, Ed, PhD: Report on Wireless Smart Meters showing the health effects, presentation, 2011, https://bit.ly/3ipeKLh....59

Ref. 99: Dart, Paul, M.D., (lead author), Kathleen Cordes, M.D., Andrew Elliott, N.D., James Knackstedt, M.D., Joseph Morgan, M.D., Pamela Wible, M.D., Steven Baker: Biological And Health Effects Of Microwave Radio Frequency Transmissions A Review Of The Research Literature – A Report To The Staff And Directors Of The Eugene Water And Electric Board, June 4, 2013, https://bit.ly/3jCDCPN....59

Ref. 100: De Kun Li: Letter from Dr. De-Kun Li, MD, PhD, MPH to the FCC on Smartmeters and the lack of public health protection, undated paper, https://ecfsapi.fcc.gov/file/7022311506.pdf [link broken as of 1.1.2023, however, similar statements from Dr. Li abound, e.g. here: https://bit.ly/3jA5t30]....60

Ref. 101: De Kun Li, Dr., researcher at Kaiser Permanente: Pre-Filed Testimony Of De-Kun Li, MD, PhD, MPH, MPUC Docket No. 2011- 00262, pages 3 – 4 (our emphasis) https://ecfsapi.fcc.gov/file/7520940945.pdf [link broken as of 1.1.2023]:....60

Ref. 102: The court of Tours requests the withdrawal of Linky meters from thirteen individuals for medical reasons, Franceinfo, 30/07/2019, https://bit.ly/3YPk7nj....61

Ref. 103: “Electrosensible, son compteur retiré par décision de justice” (Electrosensitive, her meter removed by court order), 10 décembre 2016, https://bit.ly/3jDJOHr....61

Ref. 104: “1re en France, l'électrosensibilité reconnue comme handicap” (First in France, electro-hypersensitivity recognized as handicap), https://bit.ly/3Q2TyqQ....61

Ref. 105: Iowa Final Ruling on Smartmeter Opt Out Against Interstate Power and Light 2018, https://bit.ly/3G4DOi6....62

Ref. 106: Marcus, Jay B., Marcus Law Offices: BEFORE THE IOWA UTILITIES BOARD, INTERVENORS' POST-HEARING BRIEF, DOCKET NO: SPU-2018-0007, January 4, 2019, Fairfield, Iowa, USA: https://bit.ly/3GqnEBd....63

Ref. 107: Jamieson, Isaac A, PhD DIC RIBA DipAAS BSc (Hons) MInstPS: SMART METERS – SMARTER PRACTICES, Revision 1, January 2012 EM-Radiation Research Trust, 279 p, https://bit.ly/3WA1VfY....63

Ref. 108: Lamech F.: Self-Reporting of Symptom Development From Exposure to Radiofrequency Fields of Wireless Smart Meters in Victoria, Australia: A Case Series, Altern Ther Health Med. 2014 Nov-Dec;20(6):28-39. http://www.ncbi.nlm.nih.gov/pubmed/25478801....63

Ref. 109: Marino, Andrew A: Expert Report of Andrew A Marino, August 8, 2016 Povacz v PECO, Pennsylvania Utility Commission, 2017 (Marino 2016), https://bit.ly/3Q7a1dy....63

Ref. 110: Martin Pall, Prof. em.: Testimony given during a hearing on Massachusetts Senate Bill 1864: No Fee Opt Out for Smart Meters. June, 20, 2017, shortlink: https://bit.ly/3GqxW4j....65

Ref. 111: Sage Environmental Consultants: Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters, Sage Associates, Santa Barbara, CA, USA, January 1, 2011, 100 p, https://bit.ly/3PZNCyA....65

Ref. 112: Sierck, Peter H., Industrial Hygienist: Smart Meter – What We Know, Measurement Challenges and Complexities, A Technical Paper to Clarify RF Radiation Emissions and Measurement Methodologies, EMF&RF solutions, Environmental Testing & Technology, Inc (ET&T), California, December 2011, https://bit.ly/3FTLLa0....67

Ref. 113: email 8.8.2018 from EMF Consult AS to NKOM. For a blog post with the relevant links and reviews: https://bit.ly/3i029Ok....67

Ref. 114: The Norwegian Radiation Protection Authority: “Weak radiation from smart electricity meters”, Stråleverninfo 09 17, 2 p., 21.08.2017, original version: https://bit.ly/3Q1Czov; retouched version: https://bit.ly/3jDVgCR.....68

Ref. 115: Jamieson, Isaac A: Smart Meters and Weather Extremes – Set to Fail? – What happens when weather is colder than smart meters can operate?, paper, undated, https://bit.ly/3i2vuaY.....68

Ref. 116: Leferink, Frank, Cees Keyer, Anton Melentjev: Static Energy Meter Errors Caused by Conducted Electromagnetic Interference, IEEE Electromagnetic Compatibility Magazine – Volume 5 – Quarter 4, 2016, featured in “Strømmålere viser grove feil i nederlandsk forskningsrapport Opptil 582 prosent avvik på smarte strømmålere” (Electricity meters show gross errors in Dutch research report: Up to 582 percent deviation on smart electricity meters), Din Side, 2016, https://bit.ly/3WLll0M.....68

Ref. 117: Notice of Liability template, https://www.emfhelpcenter.com/downloaddocs/NoticeOfLiability.doc.....69

Ref. 118: Powell, Ronald M., physicist, Ph.D.: Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances, June 11, 2013, https://bit.ly/3C4wP7V.....69

Ref. 119: Flydal, E: Smart about “smart meters” and health damage, 25/01/2016, https://bit.ly/3PXxait.....69

Ref. 120: Powell, Ronald M., physicist, Ph.D.: Ranking Electricity Meters for Risk to Health, Privacy, and Cyber Security, November 12, 2015 Edition 3, https://bit.ly/3I9JrOH, discussed here (Norwegian): https://bit.ly/3i0cNVi.....69

Ref. 121: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3, Part 2, section3.2.....69

Ref. 122: Alerte Phonegate: 60 plaintiffs file class action against Xiaomi, press release, 20.07.2020, https://bit.ly/3i5K3dD 71

Ref. 123: Kühling, Wilfried: 5G/Mobilfunk durch gesamträumliche Planung steuern, Kompetenzinitiative (Controlling 5G/mobile communications through overall spatial planning), Kompetenz Initiative, 2021, p. 011, https://bit.ly/3vmvg1p.....71

Ref. 123b: ICNIRP Statement, General Approach to Protection Against Non-Ionizing Radiation Protection, Health Physics 82(4):540-548; 2002.....72

Ref. 124: Tarditi, Alfonso G., Electric Power Research Institute (EPRI): Smart Metering Issues, 52nd Annual Rural Energy Conference February 12-14, 2014, La Crosse (WI), foils, https://bit.ly/3Gs9srf.....73

Ref. 125: California Council on Science and Technology (CCST): Health Impacts Of Radio Frequency From Smart Meters, 2011, https://bit.ly/3WU8vO4 :.....73

Ref. 126: Magda Havas: Havas Submission to CCST “Report on Smart Meters”, 2011, https://bit.ly/3YXb6IP.....73

Ref. 127: Daniel Hirsch: Comments on the Draft Report by the California Council on Science and Technology “Health Impacts of Radio Frequency from Smart Meters”, 31 January 2011, https://bit.ly/3WVOrdV.....73

Ref. 128: GSMA, 2015, “Smart meters: Compliance with radio frequency exposure standards”, GSMA, 2015, https://bit.ly/3Cb2hkG.....73

Ref. 129: Flydal, E: “Smart meters: the health premise that disappeared”, blog post 16/11/2017, https://bit.ly/3GrWRV6 74

Ref. 130: Letter from the Norwegian Radiation Protection Authority [then Strålevernet, now DSA] to law firm Steenstrup Stordrange DA, 29/04/2015, ref. 15/00224/301 regarding the competence of the Norwegian Radiation Protection Agency to evaluate scientific research within this field, https://bit.ly/3vr86qx (English translation in Figure 12).....74

Ref. 131: “No professional disagreement about the radiation”, newspaper interview with senior adviser Lars Klæboe, DSA, in Varden ca 16.06.2019. JPG, https://bit.ly/3Qi5AwF.....74

Ref. 132: Flydal, E: “Smart Meters: The Radiation Protection Authority clings to its misinformation”, blog post 27/06/2018, https://bit.ly/3GstCBH.....77

Ref. 133: Retouched version of the fact sheet *Strålevern Info 09-2017*, https://bit.ly/3jDVgCR.....77

Ref. 134: SINTEF Energi AS: “Evaluation of NVE's guide to safety in AMS” – consultancy report prepared for NVE, 44, 2017, https://bit.ly/3C80EV2.....78

Ref. 135: Letter from the Norwegian Water Resources and Energy Directorate (NVE) to FELO, ref. NVE 200701944-252 ek/ave, 14.03.2012, on exemption for electro-sensitive persons, https://bit.ly/3CEul0g.....78

Ref. 136: “Possible health damage as a result of low-power electromagnetic radiation”, note by retired director of technology in Televerket/Telenor ASA, Ole Petter Håkonsen, dated 1st October 2019, published on the alumni website of the former Norwegian Telecom Directorate’s Research Institute, January 2021 (excerpt):.....78

Ref. 137: Ronald M. Powell: “Ranking Electricity Meters for Risk to Health, Privacy, and Cyber Security”, pdf note, 3rd edition, dated 12 November 2015, https://bit.ly/3vrt48M.....79

Ref. 138: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW, Chapter 11 (p. 176).....82

Ref. 139: Hecht, Karl: “Is the division into ionizing and non-ionizing radiation still relevant? Latest scientific knowledge: EMF radiation can generate excess O_2 and NO radicals in the human body”, research report, Competence Initiative for the Protection of Man, Environment and Democracy e.V., 2015, http://kompetenzinitiative.net/. .82

Ref. 140: How do you make a radio wave?, Western University, Illinois, https://www.qrg.northwestern.edu/projects/vss/docs/Communications/3-how-do-you-make-a-radio-wave.html 84

Ref. 141: Blundell, Stephen: Magnetism – A very short introduction, Oxford University Press, 2012, p. 47:.....84

Ref. 142: Magee, Steven: Toxic Electricity, Edition 2 – 2013, ISBN 9781475295696, pages 247-269 which is also printed in Magee, Steven: Electrical Forensics, Edition 1 – 2013, ISBN 9781492118909, pages 216-238.....87

Ref. 143: Lloyd Morgan: “Blood Glucose Levels A Study of Correlation Factors”, PDF, revised 6/16/03,https://bit.ly/3HsjRnD:.....87

Ref. 144: Dr. Magda Havas: Health Concerns associated with Energy Efficient Lighting and their Electromagnetic Emissions, response to Request for an opinion on “Light Sensitivity” from Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), June 5, 2008, https://bit.ly/3Je0Zdc.....88

Ref. 145: Samuel Milham & David Stetzer (2013) Dirty electricity, chronic stress, neurotransmitters and disease, Electromagnetic Biology and Medicine, 32:4, 500-507, DOI: 10.3109/15368378.2012.743909.....90

Ref. 146: Örjan Hallberg, Paavo Huttunen and Olle Johansson: Cancer incidence vs. Population Average Sleep Duration on Spring Mattresses, Advanced Studies in Medical Sciences, Vol. 2, 2014, no. 1, 1 – 15, http://dx.doi.org/10.12988/asms.2014.3810.....94

Ref. 147: Anna Kochnev, Noa Betzalel, Paul Ben Ishai and Yuri Feldman: Human sweat ducts as helical antennas in the sub-THz frequency range-an overview, Terahertz Science and Technology,,ISSN 1941-7411 Vol.11, No.2, June 2018, Invited Paper.....94

Ref. 148: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, Chapter 14 Brillouin precursors, https://bit.ly/3QoQ2qW.....94

Ref. 149: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, Part 2, https://bit.ly/3BI97h3.....99

Ref. 149b: EMF Consult AS, Hjortland, OM: Test of Conducted Emission (“Dirty Electricity”) From Different Generations Of Electricity Meters, rev. April 2022, with introduction by Einar Flydal and Else Nordhagen: “Dirty power” from new electricity meters: Key to a health problem?, PDF note, https://bit.ly/3wrRrDF.....100

Ref. 150: Zaporozhan, V., & Ponomarenko, A. (2010). Mechanisms of Geomagnetic Field Influence on Gene Expression using Influenza as a Model System: Basics of Physical Epidemiology. International journal of environmental research and public health, 7(3), 938–965. https://bit.ly/3HaaLu8.....100

Ref. 151: Hans Baumer and Walter Sönning: The natural impulse frequency spectrum of the atmosphere (CD-Sferics a. t. B.) and its biological reality, 2002 (47 pages, unpublished, PDF, https://bit.ly/3WDWzPZ.....101

Ref. 152: Sönning, Walter: Weather Sensitivity and Electro-sensitivity, Research Report, Kompetenzinitiative e. V., 2013, https://bit.ly/3wtmMGd.....101

Ref. 153: Private emails to Einar Flydal, 2017 -2021.....101

Ref. 154: Warnke, Ulrich: Bees, birds and mankind – Destroying Nature by 'Electrosmog', Kompetenzinitiative e. V, 2009, https://bit.ly/3XTVpRp.....101

Ref. 155: Panagopoulos, Dimitris J. & Balmori, Alfonso: On the biophysical mechanism of sensing atmospheric discharges by living organisms, Sci Total Environ. 2017 Dec 1;599-600:2026-2034. doi:10.1016/j.scitotenv.2017.05.089.....101

Ref. 156: Rothkaelhl H, Izohkina N, Prutensky I, Pulinets S, Parrot M, Lizunov G, Blecki J and Stanislawska I: Ionospheric disturbances generated by different natural processes and by human activity in Earth plasma environment, Annals of geophysics, Supplement to Vol. 47, N. 2/3, 2004.....101

Ref. 157: Walter Sönning: “Mobile telephony and the natural impulse radiation of the atmosphere: A fundamental critique of exposure limits”, 2021, unpublished PDF note, https://bit.ly/3wroDv8.....102

Ref. 158: “Why the solar cells disturb”, Elinstallatören (a Swedish publication for electrical installers), 4. May 2020, https://bit.ly/3RlViw1 (our translation from Swedish):.....103

Ref. 159: “Per-Ove was forced to demount the solar cells: "They disturb"", El-installatören, 04 May 2020, https://bit.ly/3DdeXYQ (our translation from Swedish):.....104

Ref. 160: “Telia: "No doubt that the solar cells spread disturbances"", El-installatören, 4. May 2020, https://bit.ly/3wxTZ3k 104

Ref. 161: Luftfartsverket: “No solar cells within 3 km, thank you”, El-installatören, 4. May 2020, https://bit.ly/3Hc5geE. 104

Ref. 162: “I received criticism when I said that electric vehicles spread disturbances on the electricity grid”, El-installatören, 07 January 2020, https://bit.ly/3kGzDSO.....104

Ref. 163: “Sarah knows why hair dryers start in the middle of the night”, El-installatören, 27 March 2017, https://bit.ly/3Dh3nfy.....105

Ref. 164: “Overtones from electric cars forgotten risk for the TV set and fixtures: "May catch fire"", El-installatören, March 12, 2020, https://bit.ly/3XF5dyX.....105

Ref. 165: Lindberg, Maria: Electricity quality and disturbances in connection with charging the municipality's electric buses at the charging points Röbäck and Carlshöjd, Thesis for MSc in energy technology, civic engineering, Umeå University, May 2016, (Abstract in English), https://bit.ly/3WFhTob.....105

Ref. 166: “EMC problems in hospitals: "Nursing staff have probably gotten used to it"", Elinstallatören, 03 November 2017, https://bit.ly/3j658VR.....106

Ref. 167: Improved electrical environment in new construction – Furiren 3 at Kristianstad. (PDF) BOVERKET 1998, ISBN 91-7147-497-8. 36 pages.....107

Ref. 168: Good electrical environment from the start – Experiences from the consulting industry. (PDF) BOVERKET 1998, ISBN 91-7147-481-1, 34 pages.....107

Ref. 169: Improved electrical environment – measures to reduce electric and magnetic fields in homes. BOVERKET 1998, ISBN 91-7147-503-6. 44 pages.....108

Ref. 170: Comprehensive electrical remediation – Measures to reduce electric and magnetic fields in homes. (PDF) BOVERKET 1998, ISBN 91-7147-508-7. 40 pages.....108

Ref. 171: EMF Consult AS: EMF Protection – Electromagnetic fields and radiation – What you should know, and what you can do?, PDF, EMF Consult AS. In rev. 03.2, 2019, see pages 30 – 37, https://bit.ly/3kKz22q.....108

Ref. 172: Forshufvud, Ragnar: Housing and Health, a practical handbook for a healthier home, editor: Mimers brunn, 1998.....108

Ref. 173: https://ehtrust.org/?s=dirty+electricity.....108

Ref. 173b: https://www.stetzerelectric.com/research/.....109

Ref. 174: Leslie A. Geddes & Rebecca A. Roeder: Handbook of Electrical Hazards and Accidents, second edition, Lawyers & Judges Publishing Company, Inc., 2006 [eg. p. 24].....109

Ref. 175: EXTREMELY LOW FREQUENCY FIELDS, Environmental Health Criteria 238, WHO, 2007, https://bit.ly/3Y7vtB.....111

Ref. 176: Flydal, E: This is how we removed the magnetic field from the power cable, blog post 02.03.2018 (Norwegian), https://bit.ly/3XJTRtq.....112

Ref. 177: Frank de Vocht and Robert G. Olsen: Systematic Review of the Exposure Assessment and Epidemiology of High-Frequency Voltage Transients, Front. Public Health, 29 March 2016, https://doi.org/10.3389/fpubh.2016.00052.....113

Ref. 177b: Horsevad, Kim: Analysis of Stray Current, its Aetiology, Propagation, Relevant Measurement Protocols and Mitigative Efforts at a Pig Farm in Northern Denmark. International Journal of Science and Research (IJSR), Volume 9 Issue 1, January 2020, ISSN: 2319-7064, https://bit.ly/3WNdGPa.....114

Ref. 177c: Panagopoulos DJ, Karabarbounis A, Yakymenko I, Chrousos GP. Human-made electromagnetic fields: Ion forced oscillation and voltage-gated ion channel dysfunction, oxidative stress and DNA damage (Review). Int J Oncol. 2021 Nov;59(5):92. doi: 10.3892/ijo.2021.5272.....115

Ref. 178: “The dark side of lightening”, WaldNet, 26.3.2009, https://bit.ly/3RjvHnh.....119

Ref. 178b: “This is how Rockheim blocked the flight communication”, Adresseavisa 04.11.2013, https://bit.ly/3imSnWA 120

Ref. 179: Messbericht/Test Report (Aidon) 07/01/21, Bajog electronic GmbH, 2021,https://bit.ly/40dxZbA.....124
Ref. 180: Messbericht/Test Report (Kamstrup) 07/01/21, Bajog electronic GmbH, 2021, https://bit.ly/3JsUMKx.....124
Ref. 181: Dr. Magda Havas: Health Concerns associated with Energy Efficient Lighting and their Electromagnetic Emissions, response to Request for an opinion on “Light Sensitivity” from Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), June 5, 2008,https://bit.ly/3JyJULn.....127
Ref. 182: Havas, M. and D. Stetzer. 2004. Dirty electricity and electro-hypersensitivity: Five case studies. World Health Organization Workshop on Electricity Hypersensitivity, WHO, Prague, Czech Republic, 25-26 October, 2004. https://bit.ly/3X6Vkcp.....127
Ref. 183: Milham S, Morgan LL. A new electromagnetic exposure metric: high frequency voltage transients associated with increased cancer incidence in teachers in a California school. Am J Ind Med. 2008 Aug;51(8):579-86. doi: 10.1002/ajim.20598.....127
Ref. 184: Smart meter self-reports, https://bit.ly/3jhPSp0.....128
Ref. 185: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, Part 2, https://bit.ly/3BI97h3.....128
Ref. 186: Hecht, Karl: Health Implications of Long-term Exposure to Electrosmog – Effects of Wireless Communication Technologies, Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V., 2016, https://bit.ly/3RmPBxx.....129
Ref. 187: Hecht, K. & H.-U. Balzer (1997): Biological effects of electromagnetic fields in the frequency range 0 to 3 GHz on humans. Commissioned by the Federal Institute for Telecommunications. Contract No. 4231/630402. Review of Russian research literature between 1960 and 1996, https://bit.ly/3RiZQ69.....130
Ref. 188: Johansson O, Liu P-Y. ‘‘Electrosensitivity’’, ‘‘electrosupersensitivity’’ and ‘‘screen dermatitis’’: preliminary observations from on-going studies in the human skin. In: Simunic D, ed. Proceedings of the COST 244: Biomedical Effects of Electromagnetic Fields – Workshop on Electromagnetic Hypersensitivity. Brussels/Graz: EU (DG XIII), 1995; 52.....130
Ref. 189: D. Leszczynski, S. Joenväärä, J. Reivinen, R. Kuokka, Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood–brain barrier-related effects, Differentiation 70 (2002) 120–129.....130
Ref. 190: Lear, Richard: A Biological Model for the Diseases of Civilization, October 2018, presentation, https://bit.ly/3HIT8TR.....131
Ref. 191: Lear, Richard: A New Era of Chronic Disease in America and what’s behind it, August 2017, https://bit.ly/3JuCHvN.....131
Ref. 192: “Stress”, in Wikipedia (general adaptation syndrome).....132
Ref. 193: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3Part 2, Chapter 2 point *17 Cocktail effect and threshold value*, and Chapter 13.....132
Ref. 194: Flydal, E: “What is electro-hypersensitivity? The piece I missed, I found in Pest”, blog post, 24/10/2015, https://bit.ly/3Jvf465).....132
Ref. 195: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3, Part 2, Sections 3.2 and 5.2.....134
Ref. 196: emails between subscriber N.N., Meløy nett and Einar Flydal, 2020.....138
Ref. 197: Letter from NVE to FELO, organisation for EHS people, ref. NVE 200701944-252 ek/ave, 14.03.2012, on exemptions for electro-sensitive persons, https://bit.ly/3Kps39P.....139
Ref. 198: Refusal from OED to N.N. on appeal against NVE's decision, ref. 16/367, 2.10.2017, https://bit.ly/3XPLgVn.139
Ref. 199: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3, Part 1.....139
Ref. 200: Flydal, E: Overview of court cases on radiation and health, blog post 12.12.2022, https://bit.ly/3Kwh8LI.....140
Ref. 200b: Verdict no. 21-136295ASD-BORG/02, 03.11.2022, (Norwegian), https://bit.ly/3Z9A1rU.....141
Ref. 200c: Procedure and forms for opt-out applications both as to microwaves and dirty electricity, (Norwegian), https://bit.ly/3XVimmN.....141
Ref. 201: Flydal, E: Who decides if your WiFi router is a health hazard? – The labyrinth leading to Tordenskjold's soldiers, blog post 20.01.2017, https://bit.ly/3m52G2X.....151

Ref. 202: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012 page 168 ff., https://bit.ly/3Cu9IDW.....152

Ref. 203: Maisch, Don: The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, PhD thesis, Univ. of Wollongong, 2010, http://www.emfacts.com/the-procrustean-approach/.....153

Ref. 204: Paul Brodeur: The Zapping of America, Norton & Co, N.Y., 1977.....153

Ref. 205: Jacobsen, Eva Theilgaard: “SAR, SAM, Schwan and the Nazi connection“, Medlemsbladet, EHS-foreningen, June 2020.....154

Ref. 206: ICNIRP, 1998. “ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic And Electromagnetic Fields (UP To 300 GHz)”, Health Physics 74 (4):494-522; 1998, https://bit.ly/2GQORiO, table 6, note 5, page 511:.....154

Ref. 207: Zaporozhan, V., & Ponomarenko, A. (2010). Mechanisms of geomagnetic field influence on gene expression using influenza as a model system: basics of physical epidemiology. International journal of environmental research and public health, 7(3), 938–965, https://bit.ly/3krn7GU.....154

Ref. 208: Presman, A. S.: “Electromagnetic Fields and Life“, English edition: Springer science+business media LLC, New York, 1970.....154

Ref. 209: McFadden, Johnjoe & Al-Khalili, Jim: Life on the edge, Broadway books, New York, 2014.....155

Ref. 209b: Panagopoulos DJ (Ed.). (Dec 30, 2022). Electromagnetic Fields of Wireless Communications: Biological and Health Effects (1st ed.). CRC Press. Doi: 10.1201/9781003201052, https://bit.ly/3KA22ol).....155

Ref. 210: Law no. 2015-136 of 9 February 2015 on limitation, transparency, information and consent regarding exposure to electromagnetic waves, https://www.legifrance.gouv.fr/.....155

Ref. 211: Flydal, E: Breakthrough in Dutch law on health risks from radiation weaker than ICNIRP's exposure limits, blog post 31.12.2020, https://bit.ly/3Z97G54.....155

Ref. 212: “Smart Meters: the ordeal of an EHS”, L'age de faire, May 2018.....156

Ref. 213: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002, p. 545, https://bit.ly/3NblHMT:.....156

Ref. 214: ICNIRP, 1998. Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz). Health Phys 74:494-522, pp. 494-495, https://bit.ly/2GQORiO:.....156

Ref. 215: Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, May 2020, Volume 118, Number 5, DOI: 10.1097/HP.0000000000001210, https://bit.ly/3maoRoo:.....157

Ref. 216: Einar Flydal, Else Nordhagen and Odd Magne Hjortland: ICNIRP's new guidelines for radiation protection are based on professionally untenable documentation, allow for stronger exposure, weaken authorities' and consumers' control options, and legitimise increased health and environmentally harmful infrastructure, such as from 5G, note, 21.05.2020, https://bit.ly/3ZbHUNK.....157

Ref. 216b: Panagopoulos DJ (Ed.). (Dec 30, 2022). Electromagnetic Fields of Wireless Communications: Biological and Health Effects (1st ed.). CRC Press. Doi: 10.1201/9781003201052, https://bit.ly/3KA22ol).....158

Ref. 217: 2007-03-28 HR-2007-607-A-Rt-2007-464 Sør-Trøndelag. Compensation rights. High voltage installations. Exposure beyond the recommended levels. Reduced value and lost development opportunities. Case lost – but plaintiff got legal costs covered.....158

Ref. 218: 2011, Case 2011/524 Wanted to cancel the contract because of the transformer in the basement. Exposure below ICNIRP levels. Case lost. https://www.aftenposten.no/norge/i/rAqpA/Ma-punge-ut-for-stralfrykt.....158

Ref. 219: 2015, Case 14-103302TVI-AHER/2, Case about base stations located 30m from the house of a radiofrequency radiation specialist. Exposure below ICNIRP levels. Case lost. https://einarflydal.com/wp-content/uploads/2015/03/dommen-25032014.pdf.....158

Ref. 220: The Social Security Court: APPEAL CASE NO. 20/00456: NAV COMPLAINTS INSTITUTE The case of the king's caretaker, who had two mobile base stations right next to his head for a long time and became disabled. Exposure below ICNIRP levels. Case lost. Appeal refused, on the grounds that there was no proven connection between exposure and alleged electro-hypersensitivity or the other symptoms he suffered from. 159

Ref. 221: The Social Security Court: Ruling TRR-2011-2208 Result: electro-hypersensitivity is not recognised, functional disorder must be assessed. Exposure below ICNIRP levels. Case lost.....159

Ref. 222: The Social Security Court: Ruling TRR-2014-2880 Result: The patient firmly believes that she has electro-hypersensitivity. This is not a recognised diagnosis and therefore cannot be used to get disability benefits. Exposure below ICNIRP levels. Case lost.....159

Ref. 223: The Social Security Court: Ruling – TRR-2016-2020 Result: Exposure below ICNIRP levels. Case lost. Conditions for reinstatement not met, application refused.....159

Ref. 224: Hecht, K. “The value of cell phone radiation limits”, Kompetenzinitiative e.V., 2009, https://bit.ly/3IV3gJG.….160

Ref. 225: Michael Repacholi, Yuri Grigoriev, Jochen Buschmann and Claudio Pioli: Scientific Basis for the Soviet and Russian Radiofrequency Standards for the General Public, Bioelectromagnetics, 2012, DOI 10.1002/bem.21742.....160

Ref. 226: “Clear the air on mobile tower radiation, WHO tells India”, The Hindu, February 19, 2014, https://bit.ly/41kulx4 161

Ref. 227: Havas, Magda: When theory and observation collide: Can non-ionizing radiation cause cancer?, Environmental Pollution 221 (2017), pages 501-505, https://bit.ly/3Z8xRJt.....161

Ref. 228: Arnt Inge Vistnes, Department of Physics, University of Oslo, writes in Fra Fysikkens Verden 2 (199) 42-47, 26 June 1999:.....162

Ref. 229: EUROPAEM Guidelines 2016: Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshammer, Piero Lercher, Kurt Müller, Gerd Oberfeld, Peter Ohnsorge, Peter Pelzmann, Claus Scheingraber and Roby Thill: EUROPAEM EMF guidelines 2016 for the prevention, diagnosis and treatment of EMF-related health problems and diseases (original reference: Rev Environ Health. 2016 Sep 1;31(3):363-97. doi: 10.1515/reveh-2016-0011).....163

Ref. 230: Hedendahl LK, Carlberg M, Koppel T and Hardell L (2017) Measurements of Radiofrequency Radiation with a Body-Worn Exposure meter in Swedish Schools with Wi-Fi. Front. Public Health 5:279. doi: 10.3389/fpubh.2017.00279, https://bit.ly/3m9nQx0.....164

Ref. 231: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3.....165

Ref. 232:Seven Repeatedly Documented Findings Each Show that EMF Safety Guidelines Do Not Predict Biological Effects and Are, Therefore Fraudulent. The Consequences for Both Microwave Frequency Exposures and Also 5G, PDF note, https://bit.ly/3mdD9ok:.....165

Ref. 233: Flydal, E: New marking of electric fences from today, blog post 01.04.2016, https://bit.ly/3SAJwhy (excerpt): 165

Ref. 234: Wright, Nicola: “Downplaying Radiation Risk“, Chapter 23 in Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y., 2017.....166

Ref. 235: Adlkofer, Franz Radiation protection in conflict with science, 2011, Appendix 5 in https://bit.ly/3kzuwUQ, short note.....167

Ref. 236: Paul Brodeur: The Zapping of America, Norton & Co, N.Y., 1977.....167

Ref. 237: Alster, Norm: Captured Agency, How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates, Edmond J. Safra Center for Ethics, Harvard University, 2015, https://bit.ly/3Y5Nujx 167

Ref. 238: Jacobsen, Eva Theilgaard: “SAR, SAM, Schwan and the Nazi connection”, Medlemsbladet, EHS-foreningen, June 2020, ISSN: 2596-3767.....167

Ref. 239: Environment Health Trust is taking on The Federal Communications Commission, https://bit.ly/3EHGHWt.…167

Ref. 240: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, 590 pages (Norwegian) see especially Part 3.....167

Ref. 240b: “Norwegian Navy’s Cover-Up of Birth Defect Cluster Unravels”, Microwave News, November/December 1998, p. 4, https://bit.ly/41v8uDf.....167

Ref. 240c: “Metoderapport Radarsaken”, 2006, report on investigative journalists’ methods used for articles published in Dagbladet 15,16,17,18,19,20,21,22,23 and 26 June, 3 and 5 July, 15,16,21 and 22 August, 17 and 18 September, 4 October, 4 and 18 December, https://bit.ly/3IWINTR.....167

Ref. 241: Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, May 2020, Volume 118, Number 5, DOI: 10.1097/HP.0000000000001210, https://bit.ly/3maoRoo, p. 484, column 1. [Our comments in brackets, italics added for emphasis]:....168

Ref. 242: Sheldon Rampton and John Stauber: "Trust Us We're Experts: How Industry Manipulates Science and Gambles with Your Future", 2008....169

Ref. 243: Hill, Austin Bradford: The Environment and Disease: Association or Causation?, Proceedings of the Royal Society of Medicine, Section of Occupational Medicine, President's Address, Meeting January 14, 1965....170

Ref. 244: Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz), International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, May 2020, Volume 118, Number 5, DOI: 10.1097/HP.0000000000001210, https://bit.ly/3maoRoo:....171

Ref. 245: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002....172

Ref. 246: Framework for developing health-based electromagnetic field standards, World Health Organization, 2006, ISBN 92 4 159433 0, https://www.who.int/publications/i/item/9241594330....172

Ref. 247: Butler, Tom: Wireless Technologies and the Risk of Adverse Health Effects in Society: A Retrospective Ethical Risk Analysis of Health and Safety Guidelines, Working Paper, Univ. of Cork, 2021, PDF-paper, https://bit.ly/3ERGKPz....173

Ref. 248: Ref. 240: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, 590 pages (Norwegian) pp. 398 – 401....173

Ref. 249: Expert Reviews – Statements from Governments and Expert Panels Concerning Health Effects and Safe Exposure Levels of Radiofrequency Energy (2010-2020) https://www.ices-emfsafety.org/expert-reviews/…174

Ref. 250: "How much is safe?", Investigate Europe, 4 January 2019, https://bit.ly/3ZiqbEC....175

Ref. 251: Nordhagen EK, Flydal E. Self-referencing authorships behind the ICNIRP 2020 radiation protection guidelines. Rev Environ Health. 2022 Jun 27. doi:10.1515/reveh-2022-0037. Epub ahead of print. PMID: 35751553, https://bit.ly/3YdGnFH....175

Ref. 252: Victor Leach and Steven Weller. Radio Frequency Exposure Risk Assessment And Communication: Critique Of ARPANSA TR-164 Report. Do We Have A Problem?, ARPS42 Conference Paper, *Radiation Protection in Australasia* (2017) Vol. 34, No. 2, s. 17:....176

Ref. 252b: Marino, Andrew A. (ed.): Modern bioelectricity, Marcel Dekker Inc., 1988....177

Ref. 253: Presman, A. S., 1970. "Electromagnetic Fields and Life", English edition: Springer science+business media LLC, New York, 1970, ISBN 978-1-4757-0637-6....177

Ref. 254: Naval Medical Research Institute, NMRI (Zorach, R., & Glaser, 1971). Bibliography of Reported Biological Phenomena ('effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, 1971/72, https://www.magdahavas.com/wp-content/uploads/2010/06/Navy_Radiowave_Brief.pdf....178

Ref. 255: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002....179

Ref. 255b: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, Z-forlag, 2018, https://bit.ly/3BI97h3, Part 2, Section 6.1....179

Ref. 255c: Flydal, Einar & Nordhagen, Else (ed.): 5G and our wireless reality – high stakes with health and the environment, Z-forlag, 2019, https://bit.ly/41HYFS8, 590 pages (Norwegian) Fig. 37, p. 410....179

Ref. 256: Letter to Simonetta Sommaruga, President of the Swiss Federation, 7th January 2020 from Franz Adlkofer, et al, https://bit.ly/3EXVVXi....181

Ref. 257: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012....181

Ref. 258: Robert Baan, Yann Grosse, Béatrice Lauby-Secretan, Fatiha El Ghissassi, Véronique Bouvard, Lamia Benbrahim-Tallaa, Neela Guha, Farhad Islami, Laurent Galichet, Kurt Straif, on behalf of the WHO International Agency for Research on Cancer Monograph Working Group: Carcinogenicity of radiofrequency electromagnetic fields, The Lancet Oncology, Early Online Publication, 22 June 2011, doi:10.1016/S1470-2045(11)70147-4....181

Ref. 259: IARC Classifies Radiofrequency Electromagnetic Fields As Possibly Carcinogenic To Humans, WHO, Press release N° 208, 31 May 2011.....181

Ref. 260: IARC 2019. “Advisory Group recommendations on priorities for the IARC Monographs”, The Lancet Oncology, Published: April 17, 2019, https://doi.org/10.1016/S1470-2045(19)30246-3.....181

Ref. 261: Glomsrød, Solveig & Solheim, Ida: Health effects of electromagnetic fields, 2012, https://bit.ly/3ZqqGMR.....182

Ref. 262: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, 2018, https://bit.ly/3BI97h3, Part 2, Figure 17.....182

Ref. 263: Adamantia Fragopoulou, Yuri Grigoriev, Olle Johansson, Lukas H Margaritis, Lloyd Morgan, Elihu Richter, Cindy Sage: Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales, Rev Environ Health. Oct-Dec 2010;25(4):307-17. https://pubmed.ncbi.nlm.nih.gov/21268443/. .183

Ref. 264: Building biological guidelines for sleeping areas, supplement to the standard, Ergänzung zum Standard der baubiologischen Messtechnik SBM-2015, BAUBIOLOGIE MAES / Institut für Baubiologie + Nachhaltigkeit IBN, https://bit.ly/3Yru3BX.....183

Ref. 265: EUROPAEM Guidelines 2016: Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshammer, Piero Lercher, Kurt Müller, Gerd Oberfeld, Peter Ohnsorge, Peter Pelzmann, Claus Scheingraber and Roby Thill: EUROPAEM EMF guidelines 2016 for the prevention, diagnosis and treatment of EMF-related health problems and diseases (original reference: Rev Environ Health. 2016 Sep 1;31(3):363-97. doi: 10.1515/reveh-2016-0011).....183

Ref. 266: Bioinitiative Working Group, David Carpenter and Cindy Sage (eds). 2012. *Bioinitiative 2012: A rationale for biologically-based exposure standards for electromagnetic radiation.* http://www.bioinitiative.org/.....184

Ref. 267: BioInitiative 2012 – Conclusions Table 1-1, Defining A New ‘Effect Level’ For RFR, https://bioinitiative.org/conclusions/.....184

Ref. 268: email exchanges between E Flydal, Bjørn Amundsen (Telenor), Roger Lien (Telenor), and Sissel Halmøy, 4. - 6. December 2020.....184

Ref. 269: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012.....185

Ref. 270: Sage, Cindy, Carpenter, David, and Hardell, Lennart, 2015. “Comment on SCENIHR: 'Opinion on Potential Health Effects of Exposure to Electromagnetic Fields', Bioelectromagnetics 36:480-484, (2015)“, Bioelectromagnetics 37: 190-192 (2016):.....186

Ref. 271: Ref. 261: Glomsrød, Solveig & Solheim, Ida: Health effects of electromagnetic fields, 2012, https://bit.ly/3ZqqGMR.....187

Ref. 272: Wright, Nicola: “Downplaying Radiation Risk”, Chapter 23 in Walker, Martin J. (ed.): Corporate ties that bind – An Examination of Corporate Manipulation and Vested Interests in Public Health, Skyhorse Publishing, N.Y.,2017.....187

Ref. 273: Starkey, Sarah J.: Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionizing Radiation, Rev Environ Health 2016; 31(4): 493–503, DOI 10.1515/reveh-2016-0060.....187

Ref. 274: Conway, Erik M. and Oreskes, Naomi: Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, Bloomsbury Press, 2010.....187

Ref. 275: Pall, Martin: Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action, Reviews on Environmental Health, April 2015.....187

Ref. 276: Mention of Karl Popper: The Logic of Scientific Discovery, German version 1934, English version 1959, p. 19, cited from Wikipedia https://en.wikipedia.org/wiki/The_Logic_of_Scientific_Discovery:.....187

Ref. 277: Pall, Martin L: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, note dated 17.5.2018, memorandum sent to the European Commission, https://bit.ly/3YLV3gX.....188

Ref. 278: “City of Berkeley to require cellphone sellers to warn of possible radiation risks”, The Guardian, 16.05.2015, https://bit.ly/3Fb53bm.....189

Ref. 279: “Berkeley Cell Phone "Right to Know" Ordinance”, Tuesday, December 1, 2020, https://bit.ly/2MCkBaz.....189

Ref. 279b: Einar Flydal, Else Nordhagen and Odd Magne Hjortland: ICNIRP's new guidelines for radiation protection are based on professionally untenable documentation, allow for stronger exposure, weaken authorities' and consumers' control options, and legitimise increased health and environmentally harmful infrastructure, such as from 5G, note, 21.05.2020, https://bit.ly/3ZbHUNK.....189

Ref. 280: Guidance poster from NKOM and DSA on safety distances from base stations on roofs, https://bit.ly/3JvUWAj 190

Ref. 281: Christer Törnevik, Senior Expert, EMF and Health, Ericsson Research, Stockholm: Impact of EMF limits on 5G network roll-out, ITU Workshop on 5G, EMF & Health, Warsaw, December 5 2017, https://bit.ly/3LkTK4p. .191

Ref. 282: Mobile Terms and Conditions, Samsung, https://bit.ly/421ELlz.....192

Ref. 283: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, 2018, https://bit.ly/3BI97h3 Part 2, Section 3.2.....193

Ref. 284: Powell, Ronald M.: Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances, paper, 11. June 11, 2013, https://bit.ly/3ytIFq3.....194

Ref. 285: Bioinitiative Working Group, David Carpenter and Cindy Sage (eds). *Bioinitiative 2012: A rationale for biologically-based exposure standards for electromagnetic radiation, https://bioinitiative.org/.* Section 1 Summary for the Public, (2014 Supplement) Summary for the Public – Cindy Sage, IV. RECOMMENDED ACTIONS, B. Defining new 'effect level' for RFR, last paragraph, unpaginated.....194

Ref. 286: Powell, Ronald M.: Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances, paper, 11. June 11, 2013, https://bit.ly/3ytIFq3, Figure 1, page 9.....195

Ref. 287: Regulations on radiation protection and use of radiation (radiation protection regulations), Section 6, paragraph 5, https://bit.ly/40Hn2hk.....198

Ref. 288: Regulations on radiation protection and the use of radiation (radiation protection regulations), Section 2, https://bit.ly/40Hn2hk.....198

Ref. 289: Flydal, E: Business audit of Strålevernet – Season 1, episode 5, blog post, 26.06.2019, https://bit.ly/3J6Xjs9 199

Ref. 290: Flydal, E: The smart meter radiation and the big disclaimer: The radiation protection authority as Erasmus Montanus, blog post 28.03.2018, https://bit.ly/3Jzgf46.....199

Ref. 291: ICNIRP 2002, ICNIRP statement, General approach to protection against non-ionizing radiation, HEALTH PHYSICS 82(4):540-548; 2002.....201

Ref. 292: Radio frequency fields in our surroundings, Measurements in the frequency range 80 MHz – 3 GHz, Radiation Protection Report 2011:6, Post and Telecommunications Authority (now NKOM) and Norwegian Radiation Protection Authority (now DSA), https://bit.ly/42byzrw.....202

Ref. 293: Pall, Martin L: 5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, note dated 17.5.2018, memorandum sent to the European Commission, https://bit.ly/3YLV3gX.....202

Ref. 294: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012.....202

Ref. 294b: Waldmann-Selsam, Cornelia: Tree Damage Caused by Radiofrequency Radiation Exemplary Observations from 2005 to 2021 in Germany, slides, May 2022, https://bit.ly/3mE7g8I.....203

Ref. 295: Email from Trond Syvertsen to the Norwegian Ministry of Climate (KMD) and the Environment on 4 March 2019 (our translation):.....204

Ref. 296: Kåss, Ingrid Wreden & Halmøy, Sissel: Harmful effects of radiation from wireless technology and other EMFs are well documented, Collection of sources, references to scientific research and to warnings from the professionals, Folkets Strålevern, 2022, https://bit.ly/3ZVvt9a, pp. 28 – 32, and p. 46.....204

Ref. 297: Reply letter from the Ministry of Climate and the Environment to Trond Syvertsen 17/2914-17. July 2019, https://bit.ly/3YJWSti.....204

Ref. 298: Thill A (2020). Biological effects of electromagnetic fields on insects. Supplement to umwelt · medizin · gesellschaft | 33 | 3/2020, https://bit.ly/3YHmqri.....204

Ref. 299: Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Norwegian Institute of Public Health, 2012 p 166.....205

Ref. 300: Santini, R & al: Survey Study of People Living in the Vicinity of Cellular Phone Base Stations, Electromagnetic Biology And Medicine, Vol. 22, No. 1, pp.41-49, 2003, https://doi.org/10.1081/JBC-120020353.....207

Ref. 301: National Academies of Sciences, Engineering, and Medicine. 2020. An Assessment of Illness in the U.S. Government Employees and Their Families at Overseas Embassies. Washington, DC: The National Academies Press. https://doi.org/10.17226/25889.....208

Ref. 302: Lerchl A et al. (2015): Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Biochem Biophys Res Commun 2015; 459 (4): 585-590, https://bit.ly/400lPCi.....209

Ref. 303: The Hanseatic Higher Regional Court in Bremen has sentenced Professor Alexander Lerchl to withdraw his allegations of falsification of the REFLEX study, https://bit.ly/3lrfgK6.....209

Ref. 304: National Academies of Sciences, Engineering, and Medicine. 2020. An Assessment of Illness in U.S. Government Employees and Their Families at Overseas Embassies. Washington, DC: The National Academies Press. https://doi.org/10.17226/25889.....210

Ref. 305: [Omitted as it is a Norwegian book containing a translation of Ref. 306].....212

Ref. 306: Pall, Martin L: “5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them”, memorandum dated 17.5.2018 sent to the European Commission, https://bit.ly/3YLV3gX.....212

Ref. 307: Bevington, Michael: Selected Studies On Electrosensitivity (ES) and Electromagnetic Hyper-Sensitivity (EHS), 4th edition (March 26th 2018) https://www.emfdata.org/download.php?field=filename_en&id=244&class=CUSTOM_Docu.....213

Ref. 308: Redmayne M, Johansson O., Could myelin damage from radio frequency electromagnetic field exposure help explain the functional impairment electro-hypersensitivity? A review of the evidence. Toxicol Environ Health B Crit Rev. 2014;17(5):247-58. doi: 10.1080/10937404.2014.923356, https://bit.ly/3UhhaKl.....218

Ref. 309: Smart meter self-reports, https://bit.ly/3jhPSp0.....218

Ref. 310: Law firm Erling Grimstad AS and Einar Flydal: Smart meters, the law and health, 2018, https://bit.ly/3BI97h3 Part 2, Section 4.2.5.....219

Ref. 311: Adlkofer, Franz & al: Risk Evaluation of Potential Environmental Hazards From Low Frequency Electromagnetic Field Exposure Using Sensitive in vitro Methods, Final report REFLEX Study, 31 May 2004, https://bit.ly/3n2q41F.....219

Ref. 312: Pineal Gland – References & Studies from the early 90s, bibliography compiled by Michael Behrstecker, undated, https://bit.ly/3JQr1my.....219

Ref. 313: Susan Pockett: Electrosmog – The Health Effects of Microwave Pollution, PDF, 2021, https://bit.ly/3QoQ2qW 219

Ref. 314: Granlund-Lind, Rigmor & Lind, John: Black on White. Voices and Witnesses about Electro-hypersensitivity. The Swedish experience, 2005, https://bit.ly/3lnot6d.....220

Ref. 315: Baumer, Hans: Sferics – The discovery of weather radiation, Rowohlt, 1987, ISBN 3498004875.....220

Ref. 315b: Panagopoulos DJ (Ed.). (Dec 30, 2022). Electromagnetic Fields of Wireless Communications: Biological and Health Effects (1st ed.). CRC Press. DOI: 10.1201/9781003201052, https://bit.ly/3KA22ol).....220

Ref. 316: Bevington, Michael: Selected Studies On Electrosensitivity (ES) and Electromagnetic Hyper-Sensitivity (EHS), 4th edition (March 26th 2018), https://bit.ly/42qZhMA.....221

Ref. 317: Microwave News November/December1999: “Standards Harmonization Meeting: Russia and West Far Apart”, https://bit.ly/42r0BPy:.....222

Health complaints from the AMS meters that are now installed by the thousands in homes are no longer surprising. Today's knowledge of pulsed electromagnetic radiation and “dirty electricity” tells us that they were to be expected. There has been no shortage of warnings. We explain physics, electro-science, biology and industry strategies in words and pictures, and we reproduce research and expert legal testimony.

We also report on measurements we have had carried out on Aidon and Kamstrup meters, and explain why many people get sick from them. We don't have believe in anxiety and superstition as the causes behind these illnesses. Solid research results and hard facts suffice.

Electrical environmental pollution of the kind created by AMS meters is a new, major environmental issue. The topic is rising internationally on the political agenda from an invisible position - in step with the "green" ideal of "full electrification".

This book is designed to be read both as a popular science textbook, for lawyers to be able to cut and paste quotations and references for their pleadings, and for journalists, researchers, lay people and those who write readers' letters to newspapers.

Einar Flydal, cand. polit. & MTS (political scientist and telecom strategist), worked within the ICT sector, including; as researcher and senior strategy advisor at Telnor ASA and as university lecturer at NTNU. Since he retired in 2011, he has become an important critic of Norwegian radiation protection policy.

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