

SMART METERS, THE LAW & HEALTH

LEGAL REPORT BY THE LAW FIRM
ERLING GRIMSTAD AS
AND KNOWLEDGE STATUS
BY EINAR FLYDAL



This book from 2018, translated from Norwegian, provides you with overview, explanations and valuable references to sources on electricity smart meters and health:

In its first part, **Advokatfirmaet Erling Grimstad AS**, a Norwegian law firm, provides an overview of some legal issues related to the risk of negative health effects of smart meters. The report is highly critical of the positions on the matter taken by the Norwegian governmental agencies for health and radiation protection.

In the second part, **Einar Flydal**, retired from his positions as a scientific researcher and strategy adviser at the corporate headquarter of Telenor and adjunct professor at the Norwegian University of Science and Technology (NTNU), provides a primer on the scientific knowledge about the effects on health – acute and over time – from pulsed microwaves in general and smart meters in particular. Also, he explains how today's absurdly high exposure limits came about, and the games played to create and defend them.

“The radiation from the new smart electricity meters is so weak and infrequent that it is not dangerous to your health to have one installed at home.”

Tone-Mette Sjømoen
Head of Section,
Department of Applied Radiation,
Norwegian Radiation Protection Authority (DSA)

“We know nothing about the health aspect. We're just professional engineers.”

Guro Grøtterud,
Head of Section,
End User Market, in charge of the smart meter deployment
The Norwegian Water Resources and Energy Directorate (NVE)

“The radiation from smart meters is stronger than the radiation which, when the Soviet Russians irradiated the US Embassy in Moscow for 22 years, caused a number of cancers, birth defects and other health problems.”

Jerry Flynn,
Top cleared NATO officer
Electronic warfare specialist

Fundraising in May 2018 made the juridical investigation and the publishing of this book possible.

Foreningen for EMF-reform

Smart meters, the law and health

Part 1: The Legal Report

ADVOKATFIRMAET ERLING GRIMSTAD AS (Law firm)

Part 2: The Annexe

EINAR FLYDAL

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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

Original (Norwegian) title: *Smartmålerne, jussen og helsa*, 2nd edition, document version: 2.01, 15.08.2018, ISBN: 978-82-93187-39-4 (Downloadable at <https://bit.ly/3BI97h3>)

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

Smart meters, dirty electricity, pulses and health, by Einar Flydal and Else Nordhagen
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Preface to the English Translation

This translation of the Norwegian book “Smartmålerne, loven og helsa” (2018) has been carried out to contribute to the internationally accumulating literature meant for the wider public as to how wireless radiation in general, and from smart meters in particular, attacks both public and individual health, as well as the environment. Also, its first part may contribute to the juridical underpinning now developing all over the world to counter the expansion of wireless technology. In addition to this book’s second part being a primer to the topic, its many references to research and professional testimonies might lead the reader to important evidence to be used in discussions as well as in court.

A fourth reason behind the translation, is that this book is very often referenced in the follow up book: “Smart Meters, Dirty Electricity, Pulses and Health” by Flydal and Nordhagen, already translated into English and freely available for download.

The translation and careful layout work has been undertaken by a volunteer in the UK. Although revised by us, his massive effort made an English version possible. We are indeed very grateful for his initiative and uncredited endeavour. A few additions and updates have been made, and many broken HTTP links for referenced material as well as various errors have been fixed.

Please note that the original was published in 2018 and that the translation might be somewhat rough here and there. In particular, this concerns the translation of the book’s first part on juridical matters.

Throughout, referenced titles are translated into English. See the Norwegian original for titles in their original language.

We hope both these books may be of help to the many sufferers of smart meters, whether suffering from the transmitter’s microwaves or from the dirty electricity produced by the meter’s electronics and spread out through the electricity wiring of their home, interfering with other such sources.

Foreningen for EMF-reform
(The Association for EMF reform)

Einar Flydal

Excerpt of the Preface to the Norwegian Edition

A couple of years ago, I was contacted by an army officer who suffered severe, acute convulsions as soon as AMS/smart meters were installed in his neighbourhood. He was caught completely unaware of something he had not thought possible.

Before the end of 2018/2019, 2.9 million smart meters will be connected in this country.

I was also contacted by people who could no longer visit friends or care for elderly parents or go to work. What can they do? They felt disenfranchised. Will more people become ill in the long term?

There was clearly a need to clarify both whether and how people could become ill, and to clarify the law. So I raised money in April-May 2018 to investigate the topic and here is the result: A report on the law – and as a basis for the law, an annexe about what science knows about the health risks.

The investigation should of course have been made several years ago and more should certainly have followed. But you have to start somewhere to be able to get a better idea of the direction of the way to go.

Everyone is free to use the report as best they can. During reading, it will certainly both astonish and fascinate.

Thank you to those of you who contributed with money! Thank you to the lawyers of Advokatfirmaet Erling Grimstad AS who were willing to venture into a rather unfamiliar field.

[Their review](#) describes what lawyers think the law *is*, not what they think it *should* be. The review must be digested and interpreted.

Part 2 was initially intended as an annexe to provide the lawyers with a brief description of the facts. However, the scope expanded into a broad introduction or primer concerning the state of knowledge on microwave radiation and health in general, and in particular from AMS/smart meters.

The two parts may be read – and used – as independent documents.

Einar Flydal, 8 July 2018

See further details in the Preface of Part 2.

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Advokatfirmaet Erling Grimstad AS:

Legal issues related to the effects from of the kinds of radio communication technology used by the Norwegian AMS meters (smart meters)

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Einar Flydal:

Meters, science, exposure limits and radiation protection

Part 1: The Legal Report

REPORT

Review of the relevant legal issues related to the risk of
adverse health effects caused by AMS
(Smart meters)

This report has been prepared by Advokatfirmaet Erling Grimstad AS (www.governance.no) on behalf of our client Einar Flydal. It provides an overview of relevant legal issues related to the risk of adverse health effects caused by AMS (smart meters).

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Abbreviations and acronyms

ALARA	As Low As Reasonably Achievable
ALARP	As Low As Reasonably Practicable
AMS	Advanced Measurement and Control Systems (Smart meters)
EMF	Electromagnetic fields
Hz	Hertz, unit of frequency (oscillations per second)
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers, USA
MAF	Regulation on measurement, settlement, invoicing of network services and electric energy, neutrality of the electricity supplier, etc. 11.03.1999 No. 301. [Norwegian: "Måle- og avregningsforskriften"]
RF	Radio frequency
RF field	Radio frequency field
SAR	Specific Energy Absorption Rate
V/m	Volts per meter, unit of electric field
W/m ²	Watts per square meter, unit for power density in microwave radiation
W	Watt, unit of power
WHO	World Health Organization

Summary

This report provides an assessment of certain legal issues linked to the risk of harmful health effects of AMS (smart meters). The legal issues are described against the background of the risks of health damage that the client has explained in a separate annexe. The core of the understanding of what this report describes is related to the understanding of risk. Even if there is a low probability that health damage will occur, but the consequences are very serious, then the risk is high. The risk must be assessed both in relation to short-term effects and long-term effects. With support in the expert committees in 1995 and 2012¹, the authorities' attention has been based on the requirement for scientific evidence to show that microwave radiation (weak electromagnetic fields/non-ionizing radiation) causes health problems. Dissenting views on the risk that this type of radiation entails, put forward by professional organisations and individuals, are systematically rejected by the authorities referring to the fact that radiation below the limits and recommendations set by the ICNIRP foundation is not found to be dangerous to health.

This opinion assumes that microwave radiation can only cause damage through heating (i.e. that the radiation produces heating effects) and does not have other biological effects. Application of the limits recommended by ICNIRP, to which the authorities unilaterally adhere without further restrictions, should prevent heating from occurring with a good margin to spare. In the authorities' view, any health problems must have other causes if the exposure is below the limit for the heating effect. As can be seen from the annexe written by the client, the Norwegian Radiation Protection Authority's application of the limits from ICNIRP provides a too narrow approach to the risk prevention from health damage resulting from microwave radiation. These limits do not take into account a number of other factors in the radiation that represent a high risk of health damage, especially for children and young people.

The authorities have decided that smart meters must be installed in all households by January 2019. Smart meters emit microwave radiation as described in the annexe. In Norway, significantly higher limits for electromagnetic radiation of the type used by smart meters are allowed, than is the case in many other European countries. For comparison, for example, the Council of Europe recommends a general limit of 1,000 micro watts per square meter ($\mu\text{W}/\text{m}^2$) as an emergency measure, and 100 $\mu\text{W}/\text{m}^2$ in the long term. A number of European countries have settled at 100,000 $\mu\text{W}/\text{m}^2$ or lower. The Norwegian authorities accept 10,000,000 $\mu\text{W}/\text{m}^2$, in line with the guideline values to protect against acute heating damage as recommended by the ICNIRP.

In the administrative authority's decisions on cases where individuals request an exemption from the installation of smart meters, it is pointed out that there is no evidence in research results that there are actual adverse health effects from weak high-frequency electromagnetic fields. The administrative authorities also point out that it is the primary and specialist health services that must decide on the form of treatment for individuals.

The conclusion of our legal review is that the authorities' choice by not handling the risk in accordance with the precautionary principle is fundamentally a political decision. Through political decisions, it is obvious that measures can be implemented that reduce the risk. Without any political change of course within this area, individuals have an almost impossible task ahead of them if they are to prove to the administrative authorities or the courts that they become or risk becoming ill from smart meters. In our view, the authorities' management practices stand in stark contrast to, for example, the French authorities' introduction of a ban on the use of wireless technology in nurseries and schools. Cyprus decided in 2017 to completely ban WiFi and other wireless communication technology in public kindergartens, and stop all installation of wireless networks in primary schools. The precautionary principle dictates precisely that the youngest in society, those who

1 The expert group of 1995 issued its own report. The expert group of 2002 did the same (report 2012:3).

according to research results are most at risk, should be shielded from the risk that this type of technology represents.

Despite the fact that the authorities have consistently taken the view that the emissions from smart meters do not entail a risk of health damage, our review shows that there is a legal basis for demanding an exemption from the obligation to have a smart meter installed. However, paradoxically, such an exemption must be legally justified on the grounds that the smart meter is a health problem for the user. The review also shows that both the electricity companies and the administration comply with such applications, if a doctor provides documentation stating that health problems afflicting the network customer, or other person in a household, are causally linked to the smart meter.

The prerequisites for some of the legal assessments that appear in this report are the descriptions of the possible adverse health effects from the smart meters that the client has explained in the annexe. The core of the description from the client is that there is a risk of adverse health effects, which is known today through international research, and that a large part of this research has also come about after the report from the expert group of 2012 was presented. It was beyond our mandate to test the tenability of these factual premises.

1. Background and introduction

The Norwegian Directorate of Water Resources and Energy (NVE) has ordered the electricity grid companies to install smart meters for the purpose of collecting all the usage readings at all measurement points where electricity is supplied.² The installation must take place by January 2019. The grid company owns the metering equipment and is free to replace the metering equipment when the company considers this to be required. The network companies' responsibility for the metering equipment is also stated in the standard network connection agreement that network customers enter into with the electricity supplier.³

According to the metering and billing regulations Section 4-1, second paragraph letter, b), the electricity supplier will have an obligation to remove AMS meters (smart meters) when "the installation causes significant and documentable disadvantage for the end user". NVE has specified that "disadvantage" must be understood in the health sense.

We have been commissioned by Einar Flydal (hereinafter the client) to assess relevant legal issues based on the premise concerning the harmful effects of smart meters given by the client, as described in the separate annexe.

We do not take a final position on whether there is scientific evidence for the premises given by the client concerning the harmful effects of weak high-frequency electromagnetic fields. Such a position is not a necessary prerequisite for answering the mandate. But there is little doubt that there is considerable concern about the adverse health consequences of smart meters. As explained in the annexe, it is recognised in research communities that adverse health effects are created even below the current exposure limits. Against a background of different ways in which several countries handle this risk, we review the perceptions and policy of the Norwegian authorities. As can be seen below, the Norwegian authorities' understanding of risk is completely different from that of many other countries. France has introduced legislation which, during 2018, will ban wireless technology in nurseries and schools for health reasons.⁴ This issue has not been assessed by the authorities in Norway as far as we are aware.

Our task has been to describe relevant legal questions and issues that may have an impact on the risk associated with the communications technology used by smart meters in connection with their introduction into the electricity grid in Norway.

The report was submitted by Advokatfirmaet Erling Grimstad AS in July 2018. The report was prepared by a project group consisting of three lawyers under the leadership of lawyer Erling Grimstad. The other lawyers who have participated in the work are attorney Mats Stenmark and associate attorney Fredrik Bergsmark Grimstad.

2 The measurement and settlement regulations Sections 3-1 and 3-3

3 For Hafslund, it follows from Section 5-1 of the agreement that it is the electricity supplier that determines the type of metering equipment, owns the metering equipment and is responsible for its installation, operation and control.

4 See, i.a.: Helsemagasinet no.3 2018. The adopted bill, "Proposition de loi relative à la sobriété, à la transparence, à l'information et à la concertation en matière d'exposition aux ondes électromagnétiques" is available here: <http://www.assemblee-nationale.fr/14/ta/ta0468.asp>

2. Mandate

Our mission has been to map and explain any legal questions that may be relevant to the authorities' handling of the health risk that results from the radio communication technology that the Norwegian smart meters (AMS – meters) use. By health risk in this context, we understand this to be both acute negative effects and long-term effects. In order to provide a legal description of the health risk, we provide a description of the importance that the precautionary principle can have for the order given by NVE to the network owners to install AMS meters at all measurement points (i.e. in private households and businesses).

We also review the various legal options for individuals to demand alternative solutions such as shielding, possibly a wired solution or uninstallation of the radio communications equipment in their AMS meter. In addition, other relevant legal issues must be commented on briefly.

3. Working method and quality assurance

3.1 Introduction

The answer to the mandate is based on the description of research findings that the client has given us (contained in the annexe). The client has financed the work on this report through financial contributions from a number of individuals who want an assessment on the relevant legal issues related to the adverse health effects of smart meters. As mentioned, the descriptions of the legal assessments are based on the client's presentation of the risk of the negative health effects that smart meters can present.

The client's description is subject to quality assurance by a reference group that the client has created. The reference group has consisted of a professional engineer in electronics, an environmental adviser, a librarian, three medics and a Supreme Court lawyer. Everyone in the reference group has in-depth knowledge of various aspects of this interdisciplinary topic. A couple of the members of the group have requested anonymity. The client has therefore chosen not to publish the names of all members of the reference group, but we are aware of their identities.

While performing the assignment, we had access to information on an ongoing basis from the client. Information we have received from the reference group through the client has been compared with other information that has been available to us.⁵ However, it is the client who has ultimately been the premise provider for the risk picture on which the legal assessments in the report are based and we have not carried out independent quality assurance on these.

3.2 Background – Review of relevant research results

3.2.1 Cases of harm to health that were only recognised after many years

It is well known that the use of various chemical substances, products or materials has only been recognised as harmful to health much later than when the adverse health effects were ascertained.⁶ The harmful effects of smoking, for example, were only recognised after several decades. This type of phenomenon is not unknown to the authorities, and analysed in detail on an independent scientific basis and in public investigations. For example; NOU 2000:16 – The tobacco industry's liability for damages. Below we give some further examples of such well-known phenomena.

Asbestos was a material that obviously had great advantages for insulation and as a fire retardant when used as a building material. Asbestos remediation is now strictly regulated. There are examples of public buildings and schools that were closed after asbestos was discovered within their buildings. It took a long time before the adverse health effects of asbestos were recognised. The cause-and-effect relationship was opposed for a long time. When it became known that asbestos could cause serious adverse health effects, the use of asbestos was banned.

No one understood that contaminated drinking water was the cause of the cholera epidemic in 19th century London. Amalgam poisoning and fibromyalgia were not recognised until as late as the 1980s. The scientific majority were not listen to for long periods of time and attempts were made to ridicule them. The harmful effects of lead were unknown for a long time.

5 Flydal has, among other things, a background in Telenor's research unit and in the Telenor group's strategy unit. He has a master's degree in telecom strategy and technology management. He has been a university lecturer in telematics at NTNU and has worked full-time with the negative effects of radio communication technology since 2011 and acquired a good overview of, and produced research in his own blogposts and articles. Flydal's description in the annexe has also been reviewed by the reference group as presented above.

6 See, among others: <https://www.eea.europa.eu/publications/late-lessons-2>

Damage as a result of radioactivity was unknown for a long time. The accident at the nuclear power plant in Chernobyl in 1986 caused very extensive and adverse health effects for people, animals and plants. This and a number of other accidents at nuclear facilities in several places around the world have made the public aware of the harmful effects caused by radioactivity. The atomic bombs that were dropped on Hiroshima and Nagasaki in 1945 caused extensive destruction. Among other things, the atomic bombs had serious damaging effects that are still visible several generations after the bombs were dropped. Radiation sickness killed around 60,000 Hiroshima residents within a year of the bombs falling. Children born after the attack could have major deformities. The number of leukaemia cases peaked about five years after the attack. Around ten years after the attack, the number of cancers such as breast, lung and thyroid cancer increased. Many of the harmful effects revealed later were probably unknown at the time the nuclear weapons were used. Exposure limiting measures came many years after the harmful effects became known.

3.2.2 The expert group of 2012

In 2012, a report came from an expert group appointed by the Institute of Public Health on behalf of the Ministry of Health and Care in addition to the Ministry of Transport. Caused by a growing uncertainty in the population about the health effects of radiation from, among other things mobile phones, the expert group investigated the question of whether weak electromagnetic fields cause health damage.

The expert group concluded that there was no scientific basis for concluding that the weak electromagnetic fields around mobile phones and other transmitting equipment caused health damage.

The report does not mention smart meters in particular, but the effects of other similar wireless technology with the main emphasis on mobile phones that were used up to 2012.⁷ Gunnar Brunborg, who was central to the expert group, had before 2012 written a report on the effects that the use of mobile phones could have. The report discredits all other scientific reports that identify findings of health-damaging effects below the limits used in Norway and set by the ICNIRP. The report claims that there are methodological weaknesses in research papers that demonstrate negative effects and states that these research results are worthless and cannot be relied upon, without this being further documented by the expert group. The result, in the client's opinion, is that the expert group has constructed a picture which means that none of the danger signals pointed out in the research concerning adverse health effects, are accepted or recognised as documented negative effects.

One of the professionals in the expert committee had a cautiously divergent view.⁸ The Association for Electro-hypersensitive, FELO, had a representative as an observer on the expert committee. That person published a counter report which was presented the same day as the expert group's report. In this counter-report, there is strong criticism of the committee's consensus, working method, assessment, interpretations and conclusions. The client points out that research results that are based on publicly funded projects find health damage more often than in the research funded by the industry itself.

3.3 Legal assessments

The mandate has been answered based on the risk assessments that appear about the adverse health effects of smart meters as described in the annexe. The assumptions we make as a basis for discussing the relevant legal issues are described in outline and with explicit reference to sources, so

7 Report 2012:3 Weak high-frequency electromagnetic fields – an assessment of health risks and management practices

8 Bente Moen, UiB

that the reader can form an opinion of the scientific validity of the assumptions we have made as a basis for our legal assessment. In our view, however, the annexe is not a necessary prerequisite for benefiting from the legal assessments we have made. The reason for this is that we have presented the current law in the area and pointed out which relevant legal questions are raised based on the current legislation in the area.

4. Legal issues

4.1 Introduction and overview of legal issues

We provide a description below of the relevant legal issues. The review of the legal issues is based on the assumptions presented in the annexe to our report.

In section 4.2 below, relevant provisions in the Radiation Protection Act and regulations based on the Radiation Protection Act are reviewed.

Section 4.3 provides a description of the precautionary principle and the application of the principle for the authorities' order to install smart meters in Norway. In section 4.6 et seq., we provide an explanation of other relevant questions for individuals who have or fear adverse health effects from smart meters.

4.2 Radiation protection and permission to use frequencies

The Radiation Protection Act aims to protect life, health and the environment. From Section 1 of the Radiation Protection Act:

“The purpose of this act is to prevent the harmful effects of radiation on human health and to contribute to the protection of the environment.”

In the preparatory work for the current description of the purpose of the Act, the Ministry of Health and Welfare proposed to limit the purpose of the Act to the prevention of harmful effects on humans from radiation.⁹ Prevention of harmful effects on animals and the external environment was taken care of by other laws such as the Animal Protection Act. The ministry proposed specific areas of operation for the law.¹⁰ These were the ministry's proposals and assessment:

“The purpose of the new law is to prevent harmful effects of radiation on health and the environment. As radiation is used in a great many fields, the law cannot be aimed at a particular area of life or a limited circle of people. The law must be geared towards those forms of human activity that are important from a radiation protection point of view. This means that all the human activities mentioned in Section 2 of the bill, and activities that can be subsumed under these, can be regulated in accordance with the law. As the proper use of radiation will often require that devices and equipment are properly installed and shielded, the ministry agrees with the proposal from the National Radiation Protection Agency, which will mean that requirements can be made for safeguarding radiation protection already in connection with installation. Section 2 of the bill is designed in accordance with this. As a collective term for the types of activities or actions that come under the law, the word business is used. The term business as used in the Act is not restricted to enterprises in the sense of company or business, but includes all human activity, regardless of whether it is carried out by individuals or legal entities.”

The ministry's proposal made it clear that the bill should also cover non-ionizing radiation, i.e. the type of radiation that smart meters emit. As can be seen from the preparatory work cited above, the Radiation Protection Act requires the provision of radiation protection (also non-ionizing) when

⁹ Subdivision proposal 88 (1998-99) On the Act on radiation and the use of radiation

¹⁰ In the consultation note, the ministry proposed that the law be applied to any manufacture, import, export, transport, transfer, possession, use and handling, including waste disposal of radiation sources, as well as the release of radioactive substances. In addition, it was proposed that the law apply to human activity that can lead to increased exposure to natural radiation from the environment, for example radon in mines. As the bill also contains provisions on planning and preparedness, this is also included in the scope.

installing, for example, smart meters, to be made by the electricity supplier or a representative of the electricity supplier.

The Radiation Protection Act contains the following safety requirements and basic principles for the use of radiation:

“Section 5. Responsibility requirements and basic principles for the use of radiation

Any manufacture, import, export, transport, transfer, possession, installation, use, handling and waste disposal of radiation sources must be sound, so that there is no risk to those carrying out the business, other people or the environment. Human activity that results in elevated natural ionizing radiation from the environment must also be justified. When assessing the soundness, emphasis must, among other things, be placed on whether the benefits of the business exceed the risks that the radiation may entail, and whether the business is designed so that acute health damage is avoided and the risk of latent damage is kept as low as can reasonably be achieved. Radiation doses must not exceed set limits.

Apparatus or equipment that can emit radiation must have a proper design and function.”

It follows on in the regulations on radiation protection and use of radiation (the Radiation Protection Regulations) Section 5 that all radiation use must be justified and that the benefits must be greater than the disadvantages of the radiation:

“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, with 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.”

It also appears that for non-ionizing radiation, “all human exposure must be kept as low as good practice” dictates. What is “good practice” is defined in more detail in Section 6 of the regulations, which applies to both ionizing and non-ionizing radiation:

“Where there are no national guidelines and limits in the field of visible light and electromagnetic fields, the latest updated version of the Guidelines on limited exposure to Non-Ionizing Radiation from the International Commission for Protection against Non-Ionizing Radiation (ICNIRP) is indicative of what good practice requires.”

In practice, this means that the maximum values proposed by the ICNIRP guidelines apply as recommended limits for non-ionizing radiation in Norway. The guidelines from ICNIRP that are relevant for smart meters are from 1998.¹¹

The annexe states that both types, both low-frequency and high-frequency fields, are classified by the WHO's cancer research body as: "2B possible carcinogen". As can be seen from the annexe, low-frequency pulses are included as a particularly active component in the microwaves from the meters. The client therefore argues that the meters should also be assessed based on guidelines for low-frequency fields. Low-frequency fields have different health risks associated with them compared to high-frequency fields, according to what appears in the annexe to our report.

¹¹ There are also other alternative guidelines and limits that have been drawn up by independent doctors and scientists, and which take heart rates into account. These are described in the annexe.

Concerning the scope of the guidelines and on possible long-term health effects from exposure, the 1998 guidelines state:¹²

“... only established effects were used as the basis for the proposed exposure restrictions. [...] 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. In the case of potential long-term effects of exposure, such as an increased risk of cancer, ICNIRP concluded that available data are insufficient to provide a basis for setting exposure restrictions, although epidemiological research has provided suggestive, but unconvincing, evidence of an association between possible carcinogenic effects and exposure at levels of 50/60 Hz magnetic flux densities substantially lower than those recommended in these guidelines.”

Concerning pulses and exposure that is weaker than known to cause acute heating damage, it says:

“Exposure to pulsed EMF of sufficient intensity leads to certain predictable effects such as the microwave hearing phenomenon and various behavioural responses. Epidemiological studies on exposed workers and the general public have provided limited information and failed to demonstrate any health effects. Reports of severe retinal damage have been challenged following unsuccessful attempts to replicate the findings.

[...]

In general, the effects of exposure of biological systems to athermal levels of amplitude-modulated EMF are small and very difficult to relate to potential health effects.”

The guidelines are based on incomplete knowledge:

“There is insufficient information on the biological and health effects of EMF exposure of human populations and experimental animals to provide a rigorous basis for establishing safety factors over the whole frequency range and for all frequency modulations. In addition, some of the uncertainty regarding the appropriate safety factor derives from a lack of knowledge regarding the appropriate dosimetry.”

What is considered relevant protection measures for the high-frequency part of the frequency spectrum (100 kHz to 10 GHz) within the framework of the guidelines, is to prevent *acute heating damage*:

“Between 100 kHz and 10 GHz, basic restrictions on SAR are provided to prevent whole-body heat stress and excessive localised tissue heating;...”

The responsibility for taking adequate measures is assigned to the industries causing exposure to such radiation, ensuring that they comply with the guidelines (p. 514). Mention is made of using audible and visible warnings when the exposure level is too high, protective work clothing, etc.

In an update from 2010 of the parts of the 1998 guidelines that deal with *low-frequency fields*, ICNIRP points this out, among other things, about the health effects of *low-frequency fields*:¹³

“Epidemiological studies have suggested that long-term low-level exposure to 50-60 Hz magnetic fields might be associated with an increased risk of childhood leukaemia. However, a combination of selection bias, some degree of confounding and chance

12 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>

13 <https://www.icnirp.org/cms/upload/publications/ICNIRPLFgdl.pdf>

could possibly explain these results. In addition, no biophysical mechanism has been identified and results from animal and cellular laboratory studies do not support the notion that exposure to 50-60 Hz magnetic fields is a cause of childhood leukaemia. Therefore, the currently existing scientific evidence does not lead to the conclusion that a prolonged exposure to LF is a cause of childhood leukaemia. Evidence for cancer in adults from LF exposure is very weak. There is no substantial scientific evidence for an association between LF exposure and Parkinson's disease, multiple sclerosis, developmental and reproductive effects, and cardiovascular diseases, while for Alzheimer's disease and amyotrophic lateral sclerosis the evidence is inconclusive. Studies of symptoms, sleep quality, cognitive function have not provided consistent evidence of an effect from this type of exposure.”

As protective measures against low-frequency electromagnetic fields, ICNIRP proposes the following:¹⁴

“To prevent health-relevant interactions with LF fields, ICNIRP recommends limiting exposure to LF fields so that the threshold at which the interactions between the body and the external electric and magnetic field causes adverse effects is never reached inside the body. The exposure limits, called basic restrictions, are related to the threshold showing adverse effects, with an additional reduction factor to consider scientific uncertainties pertaining to the determination of the threshold. They are expressed in terms of the induced internal electric field strength in V/m. The exposure limits outside the body, called reference levels, are derived from the basic restrictions using worst-case exposure assumptions, in such a way that remaining below the reference levels (in the air) implies that the basic restrictions will also be met (in the body). Refer to the ICNIRP Fact Sheet and ICNIRP Guidelines for all figures and more information.

ICNIRP follows up the scientific LF related research and new information relevant to health, in particular through its reviews of the scientific research or the organization of relevant workshops, such as the Workshop on Risk Factors for Childhood Leukaemia.

Overall research has not shown to date that long-term low-level LF exposure has detrimental effects on health.”

The 2012 expert group, which considered both low-frequency and high-frequency fields, also used the baseline and reference values recommended by ICNIRP as maximum exposure values. According to the expert group, there was broad international agreement among experts that ICNIRP's recommended values for maximum exposure provide good protection against health damage from low-frequency as well as high-frequency electromagnetic fields, i.e. both against excitation of nervous tissue and harmful heating of the tissue. The expert group stated that their investigations concerned the question of whether harmful effects can also occur at exposures that are lower than ICNIRP's base and reference values. A number of other adverse health effects other than excitation of nerve tissue and harmful heating are described in the annexe to our report, but not commented on by the expert group of 2012. It is not clear that the other negative effects pointed out in the annexe have been dealt with by the authorities or that the expert group took regard for these.

Against the background of the requirement under Section 5 of the Radiation Protection Regulations that non-ionizing radiation must be kept as low as possible, sources other than ICNIRP also seem to be relevant for achieving the requirement. This means that new research results and recommendations must be assessed by the radiation protection authorities, assessments of which we have found no trace of in the material we have reviewed. The Norwegian Radiation Protection

¹⁴ Ibid

Authority only refers to recommendations given by ICNIRP, despite the fact that these recommendations do not take into account a number of health effects that appear from research results referred to in the annexe. This raises the question of whether the administrative authorities actually apply the radiation protection regulations correctly in the administrative decisions that only refer to the ICNIRP.

The ICNIRP is a foundation registered in Germany and the members are appointed by the foundation. NRK Brennpunkt (a Norwegian TV investigation series) in 2008 raised the question of ICNIRP's real independence, lobbying activities and links to the military industry and others. This is described in more detail in the annexe to this report.

The change to the radiation protection regulations in 2016 brought about another significant change in that the ALARA principle was removed as discussed in more detail below.

4.3 The precautionary principle

4.3.1 The Radiation Protection Act must safeguard the precautionary principle

The Radiation Protection and Use of Radiation Act (hereinafter the Radiation Protection Act) provides a legal regulation of radiation. The purpose of the Radiation Protection Act is to "prevent harmful effects of radiation on human health and contribute to the protection of the environment" cf. Section 1.

The Act applies to any "(...) installation, use, handling (...) of radiation sources" cf. section 2 first paragraph.

"Non-ionizing radiation" is defined in the Radiation Protection Act as "visible light, radiofrequency radiation, electric and magnetic fields or other radiation with corresponding biological effects as well as ultrasound" cf. Section 3 letter c.

The Ministry of Social Affairs and Health has stated in the preparations for the Radiation Protection Act that the precautionary principle is safeguarded in the Radiation Protection Act by the Working Environment Act Section 7 No. 1 and the Pollution Act Section 7, matching the *eligibility assessment* that Section 5 of the Radiation Protection Act imposes. The ministry has further stated that the internationally agreed principles applied in the field of radiation protection act preventively and innovatively, "in that they set a requirement to constantly assess the extent to which the use of radiation can be defended based on an assessment of advantages and disadvantages, whether alternative techniques can replace the need for radiation use, as well as what measures can be taken to reduce doses."

The ministry states in the preparatory work that there must be "strong reasons for deviating from clear international practice, which over the years has also been applied nationally in the field of radiation protection." It appears from the annexe that there is no obvious clear international practice. On the contrary, there are big differences in the level of weak electromagnetic fields different countries accept.

In the preparatory work for the Radiation Protection Act, Section 5 states that the act is an enabling act which is expected to be complemented by regulations. The regulations for the Radiation Protection Act are commented on below. In the preparatory work for the Radiation Protection Act¹⁵ section 4.4.2, the following is stated, among other things, about the health risk:

"(...)There has been a lot of research into the question of whether radio frequency radiation and low frequency electromagnetic fields pose a cancer risk. The results so far

¹⁵ Subdivision proposal No. 99 (1998-99) On the Radiation Protection and Use of Radiation Act

are somewhat mixed, but the conclusions in international professional circles seem to be that such risks have not been sufficiently documented. If such a risk exists, then it is low in the usual handling of fields, e.g. housing near power lines, use of electrical appliances, etc.”

As can be seen from the annexe to our report, the client disputes this opinion that risk is not sufficiently documented. Moreover, the statement from the preparatory work implies an opinion about risk that can be discussed.

Furthermore, the following appears in point 4.5.6 of the preparatory work:

“The energy supply in society is largely distributed via an electrical network, and the energy is consumed in electrical appliances. Questions have been raised in Norway, as well as in many other countries, about health effects due to the electromagnetic fields that arise in this system. The social implications of such conditions can be extensive, and the questions have been thoroughly investigated in many countries, as well as in Norway. This is investigated in NOU 1995:20 "Electromagnetic fields and health. Proposal for a management strategy", which has been processed by the Parliament on the basis of St. prp. No. 65 (1997-98)”

In NOU 1995:20 Electromagnetic fields and health – the health risk is commented on as follows on page 20:

“The current state of knowledge is that a number of studies, both in Norway and in many other countries, give some indication that there is a link between electromagnetic fields and cancer risk. It is unclear what the mechanisms of action are if such a cause-effect relationship exists at all. In many countries, researchers and governments have considered the need to take various measures, ranging from more general precautionary strategies to specific measures to reduce exposure to such fields. There is still considerable uncertainty as to whether the introduction of limits is the way forward.”

In a summary of international recommendations, the official group notes that all international and supranational bodies have not taken a position on whether there are long-term effects of exposure to weaker fields.¹⁶ This picture has changed, as shown in the annexe.¹⁷

The Ministry of Health and Care Services has stated the following in several cases:^{18,19}

“As we have previously reported, Norwegian health authorities have established that the radiation from AMS transmitters is not dangerous as long as it remains below the threshold limits established by law and regulations.”

4.3.2 General precautionary principle

The precautionary principle is not explicitly mentioned in the radiation protection act itself or regulations to the act, only in the preparatory work for the act as mentioned above.

The precautionary principle has been developed in both Norwegian and international law. The principle is included in regional and global treaties to which Norway is a party. The principle also

16 See NOU 1995:20, page 42.

17 See about IARC classification in the annexe

18 Appears from a letter from the Ministry of Health and Care to a private person on 14 June 2018 (ref 17/5115-10)

19 The ministry refers to the EU's scientific committee, which essentially has the same view according to the ministry: https://health.ec.europa.eu/other-pages/health-sc-basic-page/public-consultation-scenihhr-opinion-possible-effects-electromagnetic-fields-emf-human-health_en

follows implicitly from section 112 of the Constitution. The provision was adopted in 2014 and had its forerunner in earlier section 110b from 1992.

Section 112 of the Constitution reads as follows:

“Everyone has the right to an environment that safeguards his or her health and to a natural environment in which productive capacity and diversity are preserved. Natural resources shall be managed on the basis of a long-term and comprehensive approach that safeguards this right for future generations.

Citizens have the right to knowledge of the state of the natural environment and of the effects of planned and implemented interventions in nature, so that they can exercise their right under the preceding paragraph.

The State authorities shall take measures to implement these principles.”

The first paragraph of Article 112 of the Constitution, cf. the third paragraph, should be understood as a rights provision that gives everyone a right to an environment that safeguards health and a natural environment in which productive capacity and diversity are preserved. It is noted that the provision is a new provision and that there is therefore uncertainty as to how broad the rights the provision provides. The provision must nevertheless be understood as a rights provision and not a programme declaration. It provides both a substantive and procedural right.²⁰ The substantive right follows from the first paragraph, which is intended to help fulfil, among other things, the right to an environment that safeguards health.

The second paragraph of Article 112 of the Constitution guarantees every citizen procedural rights, such as the right to knowledge of the environment and, where appropriate, of the effects of planned and implemented interventions. The third paragraph of the provision obliges the State authorities to implement the rights under the first and second paragraphs. It is clear that the provision cannot be applied to every intervention. A natural understanding implies that the interference must exceed a certain threshold. How high a threshold, if any, will be difficult to determine for two reasons. Firstly, there are few legal sources that can guide an assessment. Secondly, the provision covers a wide area, including the environment in a broad sense.

The threshold will therefore vary depending on the nature of the interference in question. The right deals with the "environment" that safeguards health. A natural linguistic understanding of the term "environment" indicates that it covers, for example, environmental damage, climate deterioration and pollution. For example, radiation should be understood as a type of pollution. Since an environment that safeguards "health" is covered by the rights provision, it may be reasonable to conclude that if radiation causes negative effects on health, Article 112 of the Constitution may establish rights for such interference.

The right under section 112, first paragraph, must nevertheless be seen in connection with the third paragraph. This means that interventions that may immediately appear to be in violation of the first paragraph are nevertheless lawful if the State authorities have taken measures (the duty to take measures) that implement the principles in the first and second paragraphs. The term "measures" is linguistically considered to be broad and can refer to various forms of measures, including; legislation, regulations, grants and other measures that will secure the substantive right.

For there to be a breach of section 112 in this context, there must be a connection between the decision on AMS meters and the unwanted environmental consequences. For this, there must be an assessment of probability and consequence. Here, for example, the precautionary principle can provide guidance on how the risk should be assessed.

²⁰ Hans Christian Bugge, Textbook in environmental management law (4th edition), p. 152.

The precautionary principle is explicitly mentioned in laws within what can be called the environmental area. The precautionary principle was first enshrined in Norwegian law with the Svalbard Environment Act, Section 7:

“When an administrative body lacks sufficient knowledge of the effects a measure may have on the natural environment or cultural heritage, authority under this Act shall be exercised with the aim of avoiding possible harmful effects on the environment.”

In the preparations for the Svalbard Environment Act,²¹ the Ministry of the Environment states that the precautionary principle "entails that one must implement measures to avoid serious and irreparable damage to the environment, even if one is not fully certain of the nature of the problem and its consequences."²² Reference is also made to the committee's statement during consideration of the bill that "taking 'precautions' must be the guiding principle for the management of the area."²³

In the notes to the individual paragraphs, the precautionary principle is recognised as being expressed in several international conventions and declarations. In the notes to Section 7, it is confirmed that the principle "implies that when decisions are made about measures that may affect the environment, a safety margin should be included to avoid unintended environmental impact as a result of limited knowledge of the measure's environmental effects (...) this matters most when there may be a risk of serious or irreversible damage to the environment (...)".²⁴

Furthermore, it is established in the preparatory work that "(...) for the administration to be able to assume that a measure will not have harmful effects on the environment, this must be confirmed by relevant experience and professional documentation". This is often linked to the principle of *reverse burden of proof*. Reverse burden of proof in this context means that it must be proven that the measure will not have harmful effects on the environment:²⁵

“Firstly, the principle is important for the administration's assessment of evidence. In order for the administration to be able to assume that a measure will not have harmful effects on the environment, this must be confirmed by relevant experience and professional documentation. This is often linked to the principle of "reverse burden of proof", and has previously been expressed in Report No. 64 (1991-92) on Norway's follow-up of the North Sea Declarations.”

It appears from the preparatory work that when the principle is applied, an application can be refused on the grounds that it has not been sufficiently clarified that the measure will be harmless to the environment.²⁶

In Section 9 of the Natural Diversity Act, the same principle is enshrined in law:

“When a decision is made without sufficient knowledge of the effects it may have on the natural environment, the aim must be to avoid possible significant damage to natural diversity. If there is a risk of serious or irreversible damage to natural diversity, a lack of knowledge shall not be used as a justification for postponing or failing to take management measures.”

The precautionary principle is explained in more detail in the preparatory works to the Nature Diversity Act²⁷. It states that the principle is considered to be close to the principle of preventing

21 Subdivision proposal 38 (2000-2001) On the Act on Environmental Protection in Svalbard (Svalbard Environment Act)

22 Subdivision proposal 38 point 7.5 The Ministry's comments

23 Set S. No. 196 (1999-2000)

24 Subdivision proposal 38 s. 181

25 Subdivision proposal 38 s. 181

26 Ibid on everything in italics

27 Proposition No. 52 (2008-2009) to the Act on Management of Nature's Diversity (the Nature Diversity Act)

environmental damage.²⁸ The preparatory works state that "in the assessment of how environmental damage can be prevented, there will often be uncertainty about what environmental damage can be expected, how great it may be, and how likely it is to occur."²⁹ The principle also provides guidelines on how uncertainty should be handled and that "lack of full scientific certainty should not be used as a reason for not taking measures to prevent serious or irreparable environmental damage".³⁰

The precautionary principle is used both to justify legislation and to describe the situations in which decisions should be taken. When drafting laws in the field of environmental law, a combination of the principle of prevention of environmental damage (preventing environmental damage) and the application of the precautionary principle (i.e. what basis is required to act) is used.³¹ The precautionary principle is primarily related to the exercise of public authority.³²

In the preamble to the EEA Agreement, to which Norway is a party, the precautionary principle is explicitly mentioned:

"DETERMINED to preserve, protect and improve the quality of the environment and to ensure a prudent and rational utilization of natural resources on the basis, in particular, of the principle of sustainable development, as well as the principle that precautionary and preventive action should be taken."

The European Court of Justice (ECJ) has stated the following about the precautionary principle in a judgment³³:

"Where there is uncertainty as to the existence or extent of risks to human health, the institutions may take protective measures without having to wait until the reality and seriousness of those risks become fully apparent."^{34,35}

The first explicit reference to the principle that we have found in any court decision from the ECJ is from the Bergaderm case, where the court states:

*"(...) the appellants dispute the references to the precautionary principle in paragraph 66 of the contested judgment"*³⁶

In 2000, the European Commission published a document (*Communication*) on the precautionary principle. Such a communication from the commission is a *policy document* and has no status as a statement with binding legal effect. The document nevertheless illustrates how the commission looks at and interprets certain specified topics. The European Commission has stated the following about the scope of the principle:

"The precautionary principle is not defined in the Treaty, which prescribes it only once – to protect the environment. But in practice, its scope is much wider, and specifically where preliminary objective scientific evaluation, indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human,

28 Ibid point 8.6.1.4

29 Ibid.

30 Ibid.

31 Subdivision proposal 52 page 94. The principle has been expressed in management practice, including, for example, the release of alien organisms, including the lack of knowledge about how alien organisms affect the ecosystem and potential adverse effects. The same considerations are also highlighted in risk assessments under the Gene Technology Act. The principle is also expressly mentioned in other laws, such as the Svalbard Environment Act as mentioned above, the Predator Management Act, the Wildlife Act and the Salmon and Inland Fish Act.

32 Subdivision proposal 52 page 94.

33 The principle is included in more decisions than what is mentioned here.

34 Case 180/96 UK v. Commission, para 99.

35 The precautionary principle was not expressly mentioned in the above-mentioned ECJ judgment.

36 Case C-353/98 P Laboratoires pharmaceutiques Bergaderm a.o. v. Commission (2000) ECR 5291, para 52.

*animal or plant health may be inconsistent with the high level of protection chosen for the Community.*³⁷

In many ways, the precautionary principle involves handling a risk in an area where there are indications of a potential negative effect on the environment, plants, animals and people. The choices that are made primarily represent a political responsibility for the legislative authority. The authorities, as decision-makers, must also be aware of the degree of uncertainty in conclusions that are linked to the evaluation of available research results.³⁸ Decision-makers who identify unacceptable risks, scientific uncertainty and public concerns have a duty to find measures that are suitable to manage the risk.³⁹

In situations where action/measures, according to the precautionary principle, are necessary, the European Commission states that the following elements should be considered:⁴⁰

- *proportional* to the chosen level of protection,
- *non-discriminatory* in their application,
- *consistent* with similar measures already taken,
- *based on an examination of the potential benefits and costs* of action or lack of action (including, where appropriate and feasible, an economic cost/benefit analysis),
- *subject to review*, in the light of new scientific data, and
- *capable of assigning responsibility for producing the scientific evidence* necessary for a more comprehensive risk assessment.

The precautionary principle is recognised internationally, outside the EU/EEA area. The principle was first internationally recognised with the Rio Declaration in 1992, which states:

“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”⁴¹

The review above shows that the precautionary principle should be understood as a broad principle, and deals with health in the same way as the environment, where the principle has its greatest importance. Incidentally, the precautionary principle is included in a policy statement from the ICNIRP, but it is not in the guidelines.⁴²

4.3.3 Application of the precautionary principle in relevant laws and decisions

The precautionary principle should be applied where it is relevant in connection with the preparation of laws and regulations. The radiation protection regulations are relevant in this context. We have been given access to working documents made by the Ministry of Health and Care in connection with the preparation of a revised version of the Radiation Protection Regulations.⁴³ The description of the latest change made to the Radiation Protection Regulations below is based on the

³⁷ Communication from the Commission on the precautionary principle (2000), page 2.

³⁸ Ibid, page 3.

³⁹ Ibid.

⁴⁰ Ibid.

⁴¹ The Rio Declaration on Environment and Development of 14 June 1992

⁴² General Approach To Protection Against Non-Ionizing Radiation Protection, ICNIRP Statement, Health Physics 82(4):540-548; 2002, <https://www.icnirp.org/cms/upload/publications/ICNIRPphilosophy.pdf>

⁴³ The documents are available here: <https://dsa.no/en/legislation/Regulations%20on%20Radiation%20Protection%20and%20Use%20of%20Radiation%20-%202020.pdf>

documents available from the ministry as mentioned. As mentioned, there are no specific nor absolute national limits for non-ionizing radiation in Norway.

The Radiation Protection Regulations are issued in accordance with the Radiation Protection Act (established by royal decree 16 December 2016). In the regulations, Section 5, first paragraph, it is stated that "all radiation use must be justified". This means that "the advantages must be greater than the disadvantages caused by the radiation".

Non-ionizing radiation to which people are exposed must be "kept as low as good practice dictates", cf. Section 5, third paragraph. In practice, this means applying the reference values against thermal damage recommended by the ICNIRP as limits.

Prior to the change in the radiation protection regulations 2016, the ALARA principle was used:⁴⁴

"All radiation use must be justified. For the radiation to be justified, the benefits of allowing radiation must be greater than the disadvantages the radiation entails. Furthermore, the radiation must be optimised, that is to say that the radiation exposure must be kept as low as practically possible, taking social and economic conditions into account (the ALARA principle – As Low As Reasonably Achievable)."

The ALARA principle was removed from the regulations by the regulatory change in 2016. This is justified as follows by the Norwegian Radiation Protection Authority in its consultation letter:

"Today, the ALARA principle (As Low As Reasonably Achievable) is used in this area. The principle is that administrative and technical measures must be taken to keep the radiation doses to the individual and the population as low as possible. The ALARA principle has been used under the assumption that a health risk cannot be ruled out, no matter how low the exposure. Recent research indicates that the probability of health damage after exposure to non-ionizing radiation below the limits is so small that the use of ALARA is no longer scientifically justified. The Norwegian Radiation Protection Authority's management in this area has shown that the ALARA principle is not appropriate in areas with non-ionizing radiation, as this is too strict, taking the risk of damage into account."

As the annexe to our report shows, the academic justification is debated. A number of research reports express an understanding of risk that is at odds with the one that can be read from the consultation letter of the Norwegian Radiation Protection Authority.

In the notes to the Radiation Protection Regulations Section 5, second paragraph, it is stated that "even if exposure is below limits, exposure should be minimised if it can be done without significant disadvantages". The third paragraph of the provision states that:

"When using non-ionizing radiation sources, the benefit of using radiation must be weighed against the risk of known health damage. Radiation protection when using non-ionizing radiation sources is ensured by complying with relevant limits. Exposure to radiation below the relevant limits is not known to represent a health risk, but exposure shall nevertheless be minimised in accordance with established good practice."

The Norwegian Radiation Protection Authority stated in the consultation letter that good practice "entails that non-ionizing radiation sources must be able to be used so that the utility value is safeguarded" and that "consideration of protection against known health damage is ensured when all relevant limits are observed".

44 FOR-2010-10-29-1380 Section 5

In connection with the consultation on the aforementioned changes to the regulations, criticism is voiced against the change. Sørlandet and Vestfold hospitals state, among other things, that it is unfortunate that the prior principle which previously appeared in section 34 has been withdrawn.

The Norwegian Labour Inspection Authority stated that the change (in the radiation protection regulations) "implies that there will be stronger protection for workers than the general public when it comes to non-ionizing radiation."

Many expressed concern about the regulation of non-ionizing radiation in connection with the revision of the Radiation Protection Regulations.

In the Radiation Protection Regulations Section 6, fifth paragraph, it is stated, as mentioned above:

"Where there are no national guidelines and limits regarding visible light and electromagnetic fields, the most recently updated version of the Guidelines on limited exposure to Non-Ionizing Radiation from the International Commission for Protection against Non-Ionizing Radiation (ICNIRP) is indicative of what good practice dictates."

Section 6 subsection 5 replaces the following text that appeared in the regulations before the change:⁴⁵

"All human exposure to non-ionizing radiation must be kept as low as practicable.

Guidelines and limits for visible light and electromagnetic fields given in the most recently updated version of the guidelines on limiting exposure to non-ionizing radiation from the International Commission for Non-ionizing Radiation Protection apply as regulations."

In the notes to the Radiation Protection Regulations, reference is made, among other things, to the following references and standards:

ICNIRP (International Commission on Non-Ionizing Radiation Protection)'s "Guidelines on limiting exposure to non-ionizing radiation", 7/98. Munich, 1998.⁴⁶

"Guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz to 100 kHz)". Health Physics 99(6):818-836; 2010.

As mentioned, the latter covers *low-frequency* electromagnetic fields.

4.3.4 The precautionary principle applied to AMS (smart meters)

4.3.4.1 Introduction and overview

Based on the available research results, and based on the IARC classification 2B, there is a risk of adverse health effects from both high-frequency and low-frequency electromagnetic fields (non-ionizing radiation). Smart meters used in Norway are among the products that represent risk, seen against the background of the precautionary principle. The annexe discusses risks both related to high-frequency fields (radiation) and related to low-frequency pulsing from the AMS meters.

The understanding of risk is directly related to how one defines and understands risk according to this principle. It is explained in more detail below.

⁴⁵ FOR-2010-10-29-1380 Section 34 cf. Section 6 fourth paragraph.

⁴⁶ 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>

Norwegian authorities' handling of risks for adverse health effects of wireless networks etc. (weak electromagnetic fields) prior to the change to the radiation protection regulations in 2016, appears, among other things, from a statement from the Ministry of Health and Care in 2013:⁴⁷

“In Norway, equipment for electronic communication must comply with the limits in the Radiation Protection Regulations. The limits are set with safety margins with regard to proven harmful health effects. In Norway, we also apply the general radiation protection principle of keeping all exposure as low as practically possible, even if the levels are initially well below the limits.”

In the same statement from the Ministry of Health and Care, it is stated about the Expert Group of 2012:

“The expert group also concluded that electromagnetic fields are not the cause of health problems attributed to electromagnetic fields (often called electro-hypersensitivity).”

The amendment to the radiation protection regulations in 2016 removed the so-called ALARA principle with the consequence that only the limits recommended by ICNIRP were to be followed in Norway. The authorities' justification for following ICNIRP's recommendations is that it is not known that exposure to radiation lower than the recommended limits represents any health risk. In our opinion, this reasoning has a number of weaknesses which are reviewed below against the background of the understanding of risk that follows from the precautionary principle. Among other things, the radiation protection authorities in Norway largely renounce the right for health and other professionals to have independent opinions or professionally based assessments on the topic.

The precautionary principle gives the authorities an obvious right not to introduce legally binding rules (regulations) where there is an unacceptable risk, scientific uncertainty or reasons for public concern. This should not be understood as implying that the authorities have no duty to introduce rules (regulations) when there is such uncertainty. The principle encourages the authorities to find answers and manage any risk by providing measures that reduce the risk. If there is a risk of serious or irreversible damage, a lack of knowledge or scientific uncertainty shall not be a justification for postponing or failing to take managerial measures that reduce the risk. The principle can be understood primarily to provide a political basis for making decisions that are rooted in the precautionary principle.

As a clarification of the application of the precautionary principle, the principle can be divided into two assessment themes:

First, governments should be reluctant to introduce legally binding decisions that could result in unacceptable risks or mandates about something about which there is scientific uncertainty or public concern.

Secondly, the authorities have a duty to take administrative measures that take into account the risk of serious or irreversible damage. It is undisputed that radiation in general poses a great risk of serious or irreversible damage. As demonstrated in the annexe to our report, a number of research results show that there is a significant risk associated with the form of radiation created by smart meters.

As shown above, *public concern* about the possibility of health damage can in itself justify the application of the precautionary principle by political decision-makers.

4.3.4.2 Which understanding of risk should be used as a basis?

In accordance with the precautionary principle, risk must be understood as an expression of the combination of the probability and the consequence of an event. An event that is very likely, but has

⁴⁷ See letter of 21/05/2013 from the Ministry of Health and Care.

little consequence, can entail a high risk. In the same way, an event that is highly improbable can pose a significant risk if the consequence is serious or catastrophic. The precautionary principle is based on the risk of the event and not just the probability that a certain event will occur. When assessing the consequences, it is natural to look at the values that must be protected in risk management. This may mean that where life and health are concerned, less needs to be done before the risk is considered high or unacceptable. Furthermore, the consequences must be assessed against the background of the possibilities that exist to neutralise or repair the harmful effects and whether the harmful effects are reversible. As an illustration, reference can be made to the long-running climate debate about the risks of man-made global warming.⁴⁸

The understanding of the concept of risk is, in our opinion, clearly expressed in this part of the Rio Declaration from 1992, which we have referred to above:⁴⁹

“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”⁵⁰ [our emphasis].

4.3.4.3 Reasons for removing the ALARA principle in 2016

Above, we have explained the ALARA principle as an example of the precautionary principle being included in national legislation. The authorities removed the ALARA principle in the revised Radiation Protection Regulations (2016). In the consultation letter to Section 5 of the Radiation Protection Regulations, the Norwegian Radiation Protection Authority gave the following justification for removing the ALARA principle:

“Today, the ALARA principle (As Low As Reasonably Achievable) is used in this area. The principle is that administrative and technical measures must be taken to keep the radiation doses to the individual and the population as low as possible. The ALARA principle has been used under the assumption that a health risk cannot be ruled out, no matter how low the exposure. Recent research indicates that the probability of health damage after exposure to non-ionizing radiation below the limits is so small that the use of ALARA is no longer scientifically justified. The Norwegian Radiation Protection Authority's management in this area has shown that the ALARA principle is not appropriate in areas with non-ionizing radiation, as this is too strict, taking the risk of damage into account.”

The Norwegian Radiation Protection Authority stated in its consultation statement that the research concludes that "exposure from mobile and radio transmitters is not dangerous to health as long as the levels are below recommended limits".⁵¹

As can be seen from the annexe to our report, there are a number of research results that give a completely different picture of the risk than the opinion expressed by the Norwegian Radiation Protection Authority when the ALARA principle was proposed to be removed in 2016.

By way of comparison, the Council of Europe recommends, after reviewing research results, that the ALARA principle should apply:⁵²

48 This understanding of risk is also laid down by Mats Dämrvik and Olle Johansson in reviews on environmental health, volume 24, no. 4, 2010: <https://bemri.org/publications/exposure-guidelines/365-health-risk-assessment-of-electromagnetic-fields/file.html>

49 Radiation Protection Report 2005:8 refers to the Rio Declaration in its description of the precautionary principle: https://www.regjeringen.no/globalassets/upload/kilde/hod/hdk/2005/0003/ddd/pdfv/284938-stralevernrapport_8_2005.pdf

50 The Rio Declaration on Environment and Development of 14 June 1992

51 The Norwegian Radiation Protection Authority, Radiation Protection Info 09/17

52 Ibid, point 5.

“As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the precautionary principle should be applied when scientific evaluation does not allow the risk to be determined with sufficient certainty. Given the context of growing exposure of the population, in particular that of vulnerable groups such as young people and children, there could be extremely high human and economic costs if early warnings are neglected.”

In the preparations for the Radiation Protection Act, it is stated that "a lot of research has been done on the question of whether radio frequency radiation and low frequency electromagnetic fields entail a cancer risk" and further that "the results so far are somewhat surprising, but the conclusions in international professional circles seem to be that such risks are not sufficiently documented". This is contested and described in more detail in the annexe. In 2011, IARC (International Agency for Research on Cancer) classified radio frequency radiation as possibly carcinogenic to humans (group 2B), and classified low-frequency electric and magnetic fields in the same group 2B in 2002.^{53,54} IARC is the WHO's body for cancer research. The following appears about the spread of cancer along electrical power lines:

“Questions have been raised in Norway, as well as in many other countries, about health effects due to the electromagnetic fields generated in this system. The social implications of such conditions can be extensive, and the questions have been thoroughly investigated in many countries, as well as in Norway. This is examined in NOU 1995:20 "Electromagnetic fields and health. Proposal for a management strategy", which has been processed by the Parliament on the basis of Report No. 65 (1997-98)”

Other countries' authorities have set lower limits for both low-frequency and high-frequency fields than those that apply in Norway (see the annexe to our report). In this connection, the Norwegian Radiation Protection Authority stated the following:⁵⁵

“The Norwegian Radiation Protection Authority is not aware of any country having lower limits that are based on a scientific basis. The Norwegian Radiation Protection Authority is aware that some claim that there is new research that the authorities do not take into account, but it often turns out that this research does not meet the scientific quality requirements.”

It is difficult to see how this statement can be scientifically based when compared to the description of the research results provided in the annexe to our report.

The 1995 expert group which described low-frequency radiation⁵⁶ and the 2012 expert group both concluded, broadly speaking, that health risk from weak high-frequency electromagnetic fields (i.e. radiation below non-thermal levels) was not documented. There are many indications that these expert groups have shaped the authorities' policy in this area.

The knowledge status of possible health effects is stated in NOU 1995:20 as follows:⁵⁷

“The state of knowledge today is that, through a number of investigations both in Norway and in many other countries, there are some indications that there is a

53 http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

54 <https://monographs.iarc.fr/ENG/Classification/ClassificationsAlphaOrder.pdf>

55 The Norwegian Radiation Protection Authority, Radiation Protection Info 09/17

56 After 1995, the understanding of the effect of oxidants on human cells changed

57 NOU 1995:20, page 20

connection between electromagnetic fields and cancer risk. It is unclear which mechanisms of action exist, if such a cause/effect relationship exists at all. In many countries, research environments and authorities have assessed the need to introduce various measures – from more general precautionary strategies to specific measures to reduce exposure from such fields. There is still great uncertainty as to whether the introduction of limits is the way to go.”

In a summary of international recommendations, the official group from 1995 notes that all international and supranational bodies have not taken a decision on whether there are long-term effects from exposure to weaker fields.⁵⁸

In 2012, the Institute of Public Health (Folkehelseinstituttet/FHI) published the report from an expert group on weak high-frequency electromagnetic fields, an assessment of health risks and management practices (Report 2012:3 from the Institute of Public Health). The expert group summarised the knowledge available about exposure to weak high-frequency fields. Therefore, the expert group reviewed and assessed research within the subject area from recent years.⁵⁹ From the expert group's interpretation of the mandate they were given for their work, the following is stated:

“Part of the discussion surrounding the management of this area concerns people who experience health problems that they themselves associate with being exposed to electromagnetic fields (often referred to as electro-hypersensitivity).”

The expert group of 2012 indicated that it was well known that exposure to RF fields at a level that produces thermal effects (i.e. heating) can damage sperm cells. But the group points out that the results must be reproduced and confirmed by several research groups before conclusions can be drawn. Very few of the older studies show signs of harm to the fetus or exposure to too weak RF fields, according to the expert group, which also claimed that studies provide little evidence that there is a connection between pregnant mothers' use of mobile phones and the risk of altered behaviour and development of the child. According to the expert group, all effects other than heating and other effects mentioned in their report are hypothetical and unclear.⁶⁰

The expert group presented these three levels of precautionary measures:

Level 1: No exposure should be higher than needed to achieve the intended purpose.

Level 2: Prudent avoidance – i.e. a somewhat stricter recommendation than the ‘general caution’ expressed in level 1.

Level 3: The precautionary principle.

According to the expert group of 2012, there are no adverse health effects from weak high-frequency electromagnetic fields.⁶¹ The expert group claimed that the uncertainty in risk assessments is relatively low. No special measures were therefore recommended to reduce exposure, e.g., by changing the exposure limits. According to the expert group of 2012, the knowledge base does not provide a foundation to claim that health damage will occur from exposures to which the population is exposed in daily life.⁶² This can be perceived as contradicting what the Norwegian Post and Telecommunications Authority and the Norwegian Radiation Protection Authority stated in a report (2011) about "Radio frequency fields in our environment" where, among other things, it appears (chapter 5.2 on limits):⁶³

58 Ibid, page 42.

59 The sources for research reports on which the expert group is based appear in report 2012:3

60 Report 2012:3 section 4.2.3

61 Report 2012:3 point 1.3.2.8

62 Report 2012:3 point 1.9.1

“Research has been conducted for a long time into whether exposure to radio frequency fields can also cause health effects through mechanisms other than temperature increase. Reorganisation of charges, effects on cell membranes and auditory phenomena are some effects that are not caused by heating, so-called non-thermal effects, but they only occur at exposures far above the limit set on the basis of thermal effects. Some individual studies have shown other effects upon exposure to much weaker fields, such as altered ion transport through cell membranes, damage to DNA and effects on the production of stress hormones, but so far the studies have not been reproduced and are therefore given lower emphasis.”

The expert group advised against the implementation of measures for which there is no scientific basis.⁶⁴

As can be seen from the annexe to this report, this risk assessment is disputed, both with the research material that was available in 2012 and that available later.

The Council of Europe has stated that potential health effects from electromagnetic fields from electrical devices are the subject of ongoing investigations and there are significant public debates.⁶⁵ According to the Council of Europe, it refers to the potential harmful, non-thermal, biological effects on plants, insects, animals and humans, even if the exposure is lower than official limits.⁶⁶

The Council of Europe believes that the precautionary principle should be applied when scientific evaluation cannot determine the risk with sufficient certainty.⁶⁷ With the technological development we have today, the population is undoubtedly exposed to electromagnetic fields. The Council of Europe states that there can be high human and financial consequences if early warnings are neglected.⁶⁸

The Council of Europe criticises states for failing to implement effective and preventive measures.⁶⁹ The Council of Europe also points to the importance of independence and credibility of scientific expertise to ensure a transparent and balanced assessment of potential consequences for the environment and human health.⁷⁰

In France, a ban on mobile phones in kindergartens and schools will be introduced during 2018 due to the adverse health effects from wireless communication.⁷¹ The research organisation ANSES in France has carried out investigations of effects from electromagnetic fields and in 2017 issued a statement related to smart meters.^{72,73} This statement maintains views from a survey carried out by ANSES in 2016 which shows that there is a low probability that electromagnetic fields from smart meters resulted in adverse health effects. ANSES has published a description of the effects of RF fields, mobile phones and wireless technology, last updated 16/04/2018.⁷⁴ ANSES recommends the

63 <https://www.nrpa.no/publikasjon/straalevernrapport-2011-6-radiofrekvente-felt-i-vaare-omgivelser.pdf> page 12, middle paragraph.

64 Report 2012:3 point 1.9.1

65 Parliamentary Assembly, Council of Europe, Resolution 1815 (2011), paragraph 2.

66 Ibid, point 4.

67 Ibid.

68 Ibid.

69 Ibid, point 6.

70 Ibid, point 7.

71 Health magazine no.3 2018 p.18. See the adopted bill, "Proposition de loi relative à la sobriété, à la transparence, à l'information et à la concertation en matière d'exposition aux ondes électromagnétiques", here: <http://www.assemblee-nationale.fr/14/ta/ta0468.asp>

72 Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail

73 <https://www.anses.fr/en/content/smart-meters-new-data-do-not-alter-anses%E2%80%99s-conclusions>

74 <https://www.anses.fr/en/content/radiofrequency-radiation-mobile-telephones-and-wireless-technologies>

following risk-reducing measures, particularly for the most vulnerable population group (i.e. children and young people):⁷⁵

- ✓ *“that in ‘talk’ mode, adult intensive users of mobile telephones use hands-free accessories more systematically, and more generally that all users choose telephones with the lowest SAR values;*
- ✓ *reducing exposure in children by encouraging moderate mobile telephone use;*
- ✓ *continuing to improve exposure characterisation of the public in outdoor and indoor environments through the implementation of measurements campaigns;*
- ✓ *that studies be conducted prior to the development of new mobile telephone network infrastructures in order to characterise exposure, and that the consequences of the installation of additional relay antennas in order to reduce environmental exposure levels be examined in depth;*
- ✓ *documenting the existing installation set-ups that cause the highest exposure in the public and studying to what extent this exposure could be reduced by technical means.*
- ✓ *that maximum exposure levels (the SAR, for example) be displayed on all common devices emitting electromagnetic fields designed to be used close to the body (DECT telephones, touch-screen tablets, baby monitors, etc.), as is already the case for mobile phones.”*

Cyprus is also introducing a ban on wireless networks in kindergartens and schools.

After 2012, no investigation or governmental public summary of similar kinds of risks from weak high-frequency electromagnetic fields/radio frequencies (RF)/microwave radiation has been carried out. There is therefore no assessment provided as to the risk associated with smart meters that are or will be installed in Norwegian homes and at Norwegian workplaces.

As far as we are aware, the risk associated with the technology used by the smart meters used in Norway has not been described by the manufacturer, wholesaler or suppliers.

Reference is made to the annexe to our report which describes how the smart meters work, the health risks associated with smart meters and other health risk factors resulting from the wireless technology that smart meters use.

The lack of information from the authorities about the risk factors as well as the uncertainty shown by the research results leaves citizens with little guidance on how to protect particularly vulnerable groups such as children and young people, or what measures can be taken to minimise the risks when using wireless technology. Silence on the part of the authorities about the health risks of weak high-frequency electromagnetic fields can, in our opinion, contribute to creating a basis for excessive fear or imbalance in the knowledge-based risk picture.

4.4 The meaning of Article 8 of the ECHR and Section 102 of the Constitution – right to respect for privacy

The European Convention on Human Rights (ECHR) applies as Norwegian law, and in the event of a conflict with rules in national law, precedence shall be given, cf. Human Rights Act Sections 2 and 3. ECHR Article 8 requires the state to, among other things, respect citizens' right to respect for privacy and their home, and reads as follows:

⁷⁵ <https://www.anses.fr/en/content/radiofrequency-radiation-mobile-telephones-and-wireless-technologies>

“1. Everyone has the right to respect for their private and family life, their home and their correspondence.

2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.”

It emerges from the practice of the European Court of Human Rights (ECtHR) that severe cases of environmental pollution can affect the individual's well-being, and constitute a limitation of privacy in the home, in such a way that the impact negatively affects the individual's right to privacy according to Article 8 of the ECHR first paragraph.

This applies even if the pollution is not so severe that it poses a serious health risk. However, it is a requirement that the impact has a certain level of severity and has a direct and harmful impact on the individual's home, family or private life.

The provision's second paragraph gives the government the right to intervene in the rights that follow from the first paragraph if the measure has sufficient authority, pursues a legitimate purpose and is proportionate. It follows from conventional practice that the proportionality assessment must have in mind the balance between the protected individual interests on the one hand, and the legitimate societal needs that justify the measure on the other.

It is a general feature of Article 8 of the ECHR that the rights that follow from the first paragraph, both in terms of their nature and wording, are broad and diffuse, and that the state's right to restrict the rights under the provision's second paragraph is highly discretionary. When the specific content of the provision is to be specified in more detail, it is therefore necessary to look at how the ECHR has interpreted and practised the provision.

A decision by the authorities which means that citizens are exposed to a certain amount of electromagnetic radiation in their homes is, by its very nature, a type of case that falls under the scope of application of Article 8 of the ECHR. The extent to which citizens are protected against this type of measure, however, depends on a closer assessment of the provision.

In the case *Gaida v. Germany* (32015/05), a private person had complained to the German authorities before the ECtHR, because a base station for mobile phones had been established near the person's house.

The complainant stated that the electromagnetic radiation from the base station violated the right to privacy that followed from Article 8 of the ECHR. It was highlighted as part of the argument that the authorities had not taken sufficient account of the recent scientific discussion about potential harmful effects from this type of radiation, but unilaterally based its assessments on guidelines from certain commissions that did not sufficiently take into account the prevention of long-term effects of the radiation.

It was further shown that a precautionary approach dictated that the authorities had to be proactive in relation to possible long-term effects, and that this had to have an impact on the closer interpretation of Article 8 of the ECHR.

The ECtHR rejected the complaint citing that as long as there was no "conclusive evidence" in relation to the fact that the radiation from the base station, which was within the safety margins the authorities operated with, had harmful effects. It was within the state's "margin of discretion" to make the decisive balance between the societal interests in the measure that generated the radiation and the individual interests in avoiding the home being exposed to the radiation. The ECtHR therefore concluded that Article 8 had not been violated, and the case was dismissed.

On the basis of this decision, it must be considered unlikely that the roll-out of AMS meters to all private metering points is in conflict with Article 8 of the ECHR, unless "conclusive evidence" can be provided that the radiation is below the limits causes damage to health.

This view is also strengthened by the fact that the Norwegian regulation allows for an exemption to be applied for installation of the meter, see below. It follows from the aforementioned decision that this type of balancing measure also points in the direction that the rights in the ECHR article 8 are not violated.

If, on the other hand, a complainant is able to provide "conclusive evidence" that exposure to the radiation within the limits is actually harmful, the conclusion could be different. However, the requirement for "conclusive evidence" implies that the evidence threshold established is very strict, and that it will not be sufficient to establish doubts about the conclusions that follow from the authorities' knowledge base. In this context, see also the decision *Luginbühl v. Switzerland* (42756/02), which is based on a similar consideration.

The right to privacy is also enshrined in Section 102 of the Constitution. The provision has clear similarities with Article 8 of the ECHR, and must be interpreted in the light of this.⁷⁶ There is no evidence that the protection under Section 102 of the Constitution goes further than the protection citizens have under the ECHR article 8. The relationship between the provision and exposure to radiation from smart meters in one's own home is therefore not further problematised here.

4.5 The network companies' obligation to install AMS (smart meters) with radio communications technology

As is well known, the Norwegian authorities have required grid companies to install smart meters at each individual metering point. The duty follows from Section 4-1 of the regulation on measurement, settlement, invoicing of network services and electric energy, the neutrality of the electricity supplier, etc. 11.03.1999 No. 301 (MAF). The provision in Section 4-1 formally only comes into force on 1 January 2019. From this date, all grid companies must have installed smart meters at all measurement points in their concession areas, cf. MAF Section 4-5 first paragraph. Installations have already been carried out in many Norwegian households and at workplaces, schools, kindergartens and institutions when this report was submitted. (This deadline has been delayed several times)

The obligation for grid companies to install smart meters in the metering points is not absolute. It follows from MAF Section 4-1 second paragraph that the network companies are not obliged to install if (1) the consumption is "very low and predictable", or where the installation is of "significant and documentable disadvantage for the end user". The Norwegian Directorate of Water Resources and Energy (NVE) also has the ability to allow exemption from the obligation in "special cases", cf. MAF section 4-1 fourth paragraph.

The duty to install smart meters according to MAF Section 4-1 is aimed at the network companies, and not the end users. In order to be able to carry out the obligation to install smart meters at each individual end user, the network companies themselves must therefore ensure that a private legal basis is established for this. In practice, this is done by the fact that the network companies' obligation to install smart meters is reflected in the terms of agreement between the electricity supplier and the end user.

Section 4-2 of MAF states in more detail what functional requirements the authorities set for smart meters, which the network companies are obliged to install at the metering points. According to the provision, smart meters must

⁷⁶ cf. Rt. 2015 page 93 section 57

- a) store measurement values with a recording frequency of a maximum of 60 minutes, and could be set to a recording frequency of a minimum of 15 minutes,
- b) have a standardised interface that facilitates communication with external equipment based on open standards,
- c) could be connected and communicate with other types of meters,
- d) ensure that stored data is not lost in the event of a power failure,
- e) be able to interrupt and limit the power draw at the individual metering point, except for transformer-metered installations,
- f) be able to send and receive information about power prices and tariffs as well as be able to transmit control and earth fault signals,
- g) provide security against misuse of data and unwanted access to control functions and
- h) record the flow of active and reactive power in both directions.

As appears under letter b), there is a requirement that the smart meters must have a standardised interface that facilitates communication with external equipment based on open standards.

In this lies a requirement that the units must be able to be connected and communicate with external equipment through a standardised IP-based data interface. To this interface, it must be possible to connect different types of communication modules, where the communication protocols and interfaces must be based on open, non-discriminatory and generally available standards.

No requirement can be derived from the provision about how the unit must send the information to other recipients. For example, there is no requirement that this be done using radio communication technology. The obligation to install smart meters at the metering points can be fulfilled without using smart meters that communicate by using radio communications technology.

The network companies are responsible for all the meters and for measuring values in their network area, cf. MAF section 3-1. This means that the network companies are responsible for operation and maintenance of the equipment.

In the regulations on the obligation to install smart meters, there is no requirement for the network companies to be able to document that the smart meters used in Norway do not have any adverse health effects. Whether this type of requirement is covered by other legislation, including requirements for permitted radiation and product safety, is discussed below.

4.6 End users' right to oppose the installation of smart meters

The question of what right the end users have to oppose the installation of smart meters must be answered on the basis of the private law relationship between the electricity supplier and the end user. This is primarily regulated by the standard terms and conditions for the supply of electricity. The standard terms for the supply of electricity have been negotiated between the electricity provider's business association, Energi Norge [renamed Fornybar Norge in 2023] and the Consumer Ombudsman. As far as we can see, these terms are used by all the key players in the electricity consumer market.

It is clear from the standard terms Section 5-1 (operation and installation of metering equipment) that the electricity companies decide what type of metering equipment is to be installed for the end users, they own the metering equipment and are responsible for its installation, operation and control.

The electricity companies have the right to determine the type of metering equipment according to the standard terms Section 5-1. This right must be understood in accordance with the obligations

and restrictions that the authorities have imposed on the online companies. This is a consequence of the fact that the standard agreement for the supply of electricity must be interpreted in accordance with the law and regulations, and the online company's terms of connection, cf. the standard terms for the supply of electricity Section 4-2.

The practical consequence of this is that the grid companies' right to require end users to have smart meters installed is identical to, and does not extend beyond, the grid companies' duty to install smart meters according to MAF Section 4-1. Such an understanding of the relationship between the Section 5-1 of the standard terms and conditions and the applicable regulations on metering and settlement has also been applied in the Ministry of Petroleum and Energy's administrative practice when handling appeals against decisions to remove smart meters.

The end users' obligation under the network connection agreement to accept installation is, on this basis, identical to the network companies' obligation to install smart meters according to MAF section 4-1. This means that end users are not obliged to accept the installation of smart meters if the consumption is "very low and predictable", or where the installation is of "significant and documentable disadvantage for the end user".

In practice, it will be the latter option that is relevant to address, in relation to the negative effects of the radio communications technology used by smart meters.

When assessing whether the condition that the installation must cause "significant and documentable inconvenience for the end user" has been met, it is relevant to look at what was the legislator's purpose in establishing the exception in the regulation.

It appears from the consultation report from NVE, which is the basis for the provision, that the condition primarily refers to disadvantages in the health sense. The Ministry has also subsequently adopted such an understanding. End users who believe they cannot have a smart meter for health reasons, will therefore be able to get an exemption, cf. MAF Section 4-1 second paragraph letter b.

In order for health reasons to qualify for smart meter exemption, it is a prerequisite that they are in a correlating causal relationship with the smart meter and that they are of a certain magnitude. There is no legal requirement that only physical, documented and measurable health effects fulfil the condition of "significant disadvantage". Therefore, it is not decisive whether the health problems are of a physical or mental nature. Health complaints of a psychological nature are also covered.

It is assumed by the authorities that, in general, strict practice is necessary when it comes to assessing exemptions from the installation of smart meters.

There are basically three different types of end users who do not want a smart meter installed at their metering point regarding health: Firstly, there will be a group who actually experience negative physical or mental health consequences from the smart meter. Secondly, we have the group who have a history of electro-hypersensitivity and for this reason reasonably expect that the smart meter will have adverse health consequences. Thirdly, we have the group of people who neither experience nor have experienced adverse health consequences from electromagnetic radiation in the past, but who nevertheless do not want to be exposed to this type of radiation based on a pure risk averse mindset.

It is clear that the first group – people who experience that the meter has a negative impact on their physical or mental health – will be entitled to an exemption under the provision. The same must apply to the group with a history of being electrically hypersensitive who reasonably expect that an installation will entail a significant disadvantage. Practice from the network companies shows that exemptions are also granted in cases where it is documented that exposure to the radiation from an AMS meter will cause health problems for the end user.

According to its wording, the provision does not grant an exemption for the type of case where the end user does not experience any adverse health effects from the smart meter, but nevertheless wants no such installation on the basis of a general consideration of the risk that exposure from the radio communications technology in the meters may cause future health problems. Nor is there any other evidence in the legal source material for such an interpretation. This means that this type of case is basically not entitled to an exemption from the installation obligation.

In order for an exemption to be granted on the basis of the condition of "significant disadvantage", it is a prerequisite that documentation can be provided that the health problems are in a correlating causal relationship with the smart meter. No further guidance has been given on how the health problems should be documented, nor has it been specified what form the documentation should take. In order to be able to prove that a smart meter leads to health problems for the end user, as a general rule, a declaration from a doctor or other relevant health personnel is necessary. The electricity companies have also, in practice, set such a demand on the end user.

In order for the documentation to comply with the legal conditions for exemption, it must appear from the declaration that it is the expert's assessment that there is a causal connection between the smart meter and the health problems, and that these are of such a nature that they are of a significant disadvantage from a health perspective for the patient. In order to determine whether the law's conditions for exemption have been met, it is not necessary, in addition to the above, to explain in more detail whether the ailments are of a physical or psychological nature.

A review of the practice by the electricity companies shows that they are relatively lenient when it comes to the requirements for the detailed content of the documentation that is submitted. A doctor's statement that does not express anything other than that the patient has approached the doctor and explained that they are experiencing adverse effects resulting from the AMS meter, seems to be accepted as sufficient for exemption to a large extent, even if in reality there is a basis for asking stricter requirements of the documentation. It looks like the practice of the power companies is not as strict as the underlying legal basis suggests.

In their practice, the grid companies and NVE also do not seem to want to check the professional assessments on which the doctor's statement is based, and as far as we can see, exemptions are granted for smart meters in most cases where more or less adequate documentation from a doctor is presented. Such a lenient practice probably also has the best of reasons for being so. However, it is assumed that the electricity companies theoretically have the legal opportunity to review the documentation if they wish, for example where a medical certificate only refers to the patient's own perception of the causal relationships and nothing is said about the doctor's own assessments.

In a statement to GPs on 14 March 2018, the Norwegian Directorate of Health pointed out that there is no basis for knowledge that radiation from AMS meters entails a health risk and that GPs who issue a certificate that a patient has complaints caused by AMS will be acting in breach of Section 15 of the Health Personnel Act.

It follows from the provision that the person who issues a certificate, declaration etc. must be careful, accurate and objective. The Directorate of Health's point of view is based on the fact that the Institute of Public Health's summary from 2012 on the state of knowledge and that measurements from the Norwegian Radiation Protection Authority do not provide evidence for health risks, and also implicitly on the view that other knowledge bases do not provide a basis for other sound conclusions.

In our opinion, the Directorate of Health's statement is based on an incorrect legal opinion. A doctor or other relevant healthcare personnel can and should be able to issue a declaration on the basis of a different basis of knowledge other than what the Norwegian Directorate of Health refers to in its statement, without acting in contravention of Section 15 of the Healthcare Personnel Act.

The requirements under Section 15 of the Health Personnel Act must be understood in connection with the duty of responsibility in Section 4, which also applies to health personnel issuing certificates, declarations, etc. or work as experts. The accountability requirement according to Section 4 entails a duty for individual health personnel to act in accordance with professional norms and statutory requirements for the practice of the profession, in addition to a duty to keep professionally up-to-date.

The duty to be professionally up-to-date will also apply when healthcare personnel prepare certificates/declarations. As long as the health personnel's assessments are professionally sound, the health personnel are free to build on a different knowledge base than the Directorate of Health refers to and thus also come to other conclusions, without infringing section 15 of the Health Personnel Act.

In chapter 5 below, concrete recommendations are given as to what should appear from an application for exemption for the installation of a smart meter, and what should appear from the documentation that must accompany the application.

4.7 Citizens' right to object to the installation of AMS by a third party.

It is stated that the adverse health effects resulting from smart meters can arise from smart meters installed elsewhere than in one's own home, for example at the workplace, neighbours in adjoining apartments or in common areas within various condominiums. There are therefore cases where people exposed to adverse health effects want to demand uninstallation, a wired solution or other measures for third parties.

A right to demand measures that remedy adverse health effects from smart meters installed for others can conceivably follow directly from the contractual relationship between the electricity supplier and the end user, or from general neighbourhood law.

The starting point for assessing whether the agreement between the electricity supplier and the end user allows for the right to demand measures that remedy any negative effects from smart meters installed for others, is based on an interpretation of the agreement based on the standard conditions for network rental, in light of the network companies' obligations towards the authorities as determined in MAF.

The exemption that can be granted pursuant to MAF Section 4-1 second paragraph letter b) is limited according to its wording to the end user, i.e. the household that has entered into the contract with the electricity supplier, cf. regulation Section 1-3. A natural understanding of the wording therefore indicates that electricity customers cannot claim exemption from the requirement to install a smart meter on the basis that they want to take into account people who do not live in the home. This is also the basis of administrative practice.

However, the point of view that electricity customers cannot claim exemption from the requirement to install a smart meter, citing that they want to take into account people who do not live in the home, can be challenged. It can be argued that an expanding interpretation of the wording must be used as a basis, so that an exemption can also be granted when a smart meter is a significant problem to other than members of the household, for example neighbours.

Characteristic of housing in densely built-up areas is that people live in buildings with many housing units. Any negative consequences from the use of the radio communications technology in smart meters will therefore not in practice be limited to the members of the respective housing unit. The consideration behind the provision in MAF Section 4-1 therefore dictates that the end user should be able to claim an exemption on the basis that the meter is a significant problem to others at

the installation site. As stated above, this point of view is contrary to administrative practice, but in our opinion is nevertheless procedural.

Under any circumstances, MAF Section 4-1, fourth paragraph, will be able to authorise a dispensation for these cases, based on a solid assessment of whether there is a qualified majority of benefits by granting a dispensation in the specific case. Normally, some reason is needed to deviate from the main rule of the regulation, but this will still be relevant here, because since such cases are of a kind close to the situations for which the regulation provides an exemption, and where the same considerations apply.

A right to demand measures that remedy any negative effects from smart meters installed for someone other than yourself can conceivably also follow from neighbourhood law.

Section 2 first paragraph of the Neighbourhood Act sets out the general limit of tolerance in neighbouring relationships, and formulates a requirement that no one must have, do or implement anything that is unreasonable or unnecessary to the detriment or disadvantage of the neighbouring property. The provision provides instructions for a specific discretion. More detailed guidelines for discretion are given in the provision's second to fourth paragraphs.

The disadvantage that might be the issue here is that the influence is dangerous, in the sense that it can cause health damage. That something is dangerous is considered a disadvantage, cf. Section 2, first paragraph, second sentence. It is based on case law that the provision must be understood so that it uses an objective concept of danger; there must be real danger. It is not enough that a person subjectively experiences something as dangerous, if there is not a sufficient factual basis for fear.

The specific assessment of whether something, objectively speaking, is sufficiently dangerous for the disadvantage condition in Section 2 first paragraph of the Neighbourhood Act to be met, must be based on the guidelines drawn up by the Supreme Court in similar cases. In Rt. 2007 page 464 section 76 et seq. the Supreme Court assumed that the assessment of whether something is sufficiently dangerous for the tolerance limit in Section 2 of the Neighbourhood Act to be violated, must be based on sources recognised within the area in question. It was further stated that the existing risk must also exceed a certain level. In this context, it was emphasised that when assessing the size of the risk, it will be relevant to compare it with the risks of daily life in other areas.

The assessment of evidence that must be carried out when deciding whether there is a real risk of health damage, must be based on the civil law proof requirement of a preponderance of probabilities. In practice, this means that it must be more likely than not that such a risk exists. In legal practice, it is assumed that disagreement in the professional environment is not in itself sufficient for the proof requirement to be met.⁷⁷

It follows from the above that the tolerance limit in Section 2 of the Neighbourhood Act will be violated in cases where

- (1) on the basis of recognised sources, it is more likely than not that there is a real risk of harm to health by being exposed to the radio communications technology from the neighbour's AMS, and
- (2) in addition, the risk is not of a theoretical nature, but exceeds the risks of daily life in other areas.

If it is assumed that it can be proven that exposure to radio communications technology, weak high-frequency electromagnetic fields or microwave radiation from the neighbour's smart meter entails a real risk of health damage, it will nevertheless, in practice, still be doubtful whether the requirement that the risk must be of a certain magnitude is met and exceeds the other risks of

⁷⁷ cf. Borgarting Court of Appeal 21 January 2011 (LB-2009-150451)

everyday life. This question can come to the fore in very specific cases where the end user suffers acute health problems.

In this type of assessment, the courts pay significant attention to whether the authorities have found reason to establish a ban on the specific exposure, the limits and the knowledge base the authorities themselves relate to. See for example the argument in Rt. 2007 page 464. In this case, it will mean that the conclusion from the court according to current law will be that the tolerance limit in Section 2 of the Neighbourhood Act has not been violated, because a possible risk will not exceed the risk of daily life in other areas.

4.8 On disputes regarding installation or uninstallation of AMS

If the electricity supplier and the end users do not reach an agreement on rights and obligations in the customer relationship, the question arises as to which dispute resolution mechanisms exist.

The standard terms and conditions for the connection and supply of electricity between the supplier and consumer provide further guidance on how this type of dispute should be handled. It appears from the terms that disagreements about "terms for connection and use of the network" can be brought to the Norwegian Directorate of Water Resources and Energy (NVE), which will then make a decision on the matter. It also appears that disputes regarding the standard supply of electricity agreement can otherwise be submitted to the Electricity Complaints Board (Elklagenemnda), or brought before the courts.

The standard terms and conditions seem to set up a two-track system, where disputes between the electricity supplier and the end user are, depending on the circumstances, either to be resolved through an administrative law complaint process, or through a civil law process in the Electricity Complaints Board and the courts. The route in which the dispute should be resolved depends on whether it concerns "disagreement about conditions on connection and use of the network", which must be resolved through an administrative complaint, or whether it is a dispute "in connection with the standard network connection agreement in general", which must be resolved in civil law, cf. Section 17 of the standard terms and conditions for network rental.

Based on the wording of the standard contract, it is unclear whether the issue of installing or uninstalling a smart meter concerns "disagreement on conditions for connection and use of the network", or whether this is a dispute "in connection with the standard network connection agreement in general". MAF Section 4-1 third paragraph, however, provides that disagreements about the installation of smart meters can be submitted to NVE for decision. It is therefore natural to understand the standard agreement as meaning that this type of dispute is to be settled in the administrative law track.

In practice, this type of dispute has been handled by administrative law complaints to NVE. Decisions from NVE may be appealed to the Ministry of Petroleum and Energy, according to the rules in the Administration Act, Chapter IV.

A decision from the ministry can further be appealed to the Civil Ombudsman, or tried by the ordinary courts, according to the rules on judicial review of administrative decisions. In such cases, the court's competence is limited to testing whether the administrative measure is valid or not.

The fact that the court's competence is limited to testing the validity of the administrative measure does not, however, prevent the court, unbound by the administration's view, from taking a position on the fundamental underlying question of whether smart meters involve any health risks. It is certainly true that an administrative decision can be deemed invalid if it is based on an incorrect fact, and the error may have affected the content of the decision.⁷⁸ Often, the reason that the

⁷⁸ cf. Torstein Eckhoff and Eivind Smith, *Administrative law*, 9th edition 2010, pages 493–494

administration has been based on the wrong fact is that the administration has not investigated the matter sufficiently. However, this is not a sufficient condition for an administrative decision to be considered invalid.⁷⁹ If the decision is based on an incorrect factual basis, it can be considered invalid even if the administration cannot be blamed for its error.⁸⁰

A legal action before the courts is costly and in this sense a less relevant option for the individual end user who has not been successful in an application not to have a smart meter installed. On the other hand, such a process may be more relevant if one or more interest groups want to finance such a lawsuit, with the principle purpose being to test the authorities' position that radiation from smart meters does not entail any kind of health risk. Depending on the circumstances, there may also be an opportunity for a stakeholder group to intervene in such a lawsuit as an *amicus curae* (friend of the court), cf. the Disputes Act Section 15-7.

4.9 The validity of regulations

4.9.1 Introduction

There is ample reason to question whether the radiation protection regulations and regulations on the introduction of smart meters take sufficient account of the health risks associated with non-ionizing electromagnetic fields. We have therefore chosen to take a closer look at the regulations and the Public Administration Act's rules for such regulations – as they are in Norway at the time of writing.

4.9.2 The Administration Act's rules on regulations

The Administration Act has certain provisions on regulations in chapter VII.⁸¹ A regulation can be amended or repealed at any time by the competent authority.⁸² Any errors in a regulation can be invoked as a basis for claims against the courts.⁸³ The authority that issues the regulation must ensure that the case is as well informed as possible before decisions are made. Errors or deficiencies in the processing of a regulation can ultimately result in the regulation being declared invalid.⁸⁴

4.9.3 The regulation on the introduction of smart meters

As mentioned above in chapter 4, the legal basis for the introduction of smart meters is set out in the regulations on metering, settlement, invoicing of network services and electrical energy, the neutrality of the grid company, etc.⁸⁵ The obligation to install smart meters was added by regulation 3 February 2017 no. 120 (came into enforcement on 1 January 2019). NVE is the regulatory authority granted authority to draft chapter 4 of the regulation.⁸⁶ NVE, as an administrative authority, has an independent duty of diligence and investigation when preparing regulations.⁸⁷ We have been given access to relevant documents in connection with the preparation of the regulations. There is no information in these documents indicating that the Norwegian Radiation Protection Authority was asked to assess or at its own behest assess any adverse health effects or risks when establishing the regulation. We cannot see that the topic was raised during the preparation of the regulation.

79 cf. Rt. 2013 page 1424

80 cf. Eckhoff and Smith, op. cit. page 493

81 Torstein Eckhoff and Eivind Smith in Administrative Law (9th edition).

82 Torstein Eckhoff and Eivind Smith in Administrative Law (9th edition).

83 See e.g. Rt 1992. p. 1700

84 See Rt 1993 p. 420

85 <https://lovdata.no/pro/#document/SF/forskrift/1999-03-11-301>

86 [Source absent in original]

87 Administrative Act Chapter VII

4.9.4 The Radiation Protection Regulations

The Norwegian Directorate of Health, by its – at the time – subdivision “The National Radiation Protection Agency”, was the administrative authority that laid down the radiation protection regulations. The Norwegian Radiation Protection Authority is the administrative and supervisory authority and has the task of being professionally up-to-date on health effects of EMF.⁸⁸ In practice, the Norwegian Radiation Protection Authority's management of the subject area rests on recommendations from ICNIRP, as mentioned above. It is therefore not the employees of the Norwegian Radiation Protection Authority who make assessments of whether electromagnetic fields have health effects or not.⁸⁹

In the consultation letter, it was stated that the chapter on medical radiation use was assessed against the radiation protection directive in the EU (Council Directive 2013/59/Euratom), but that the directive was not binding for Norway. At the same place in the consultation letter, the following appears: "Nevertheless, there is a long tradition that Norway should, as a minimum, be at the same level of protection as the rest of Europe." This statement does not differentiate between different forms of radiation and must therefore be understood as a general statement from the authorities. A natural interpretation of the statement is that it should be relevant also to look at the levels of protection not only set by the EU, but also suggested by the Council of Europe and practised by several countries in Europe.

During the consultation on the preparation of the current radiation protection regulations, the proceedings for the amendment of the Radiation Protection Regulations were criticised. The consultation memorandum was sent out on 20 June 2016 with a response deadline of 20 September of the same year, which gave limited time to prepare a consultation statement for several of the stakeholders. In addition, a number of relevant stakeholders were not included in the consultation list. It was random whether they found out about the consultation and whether they had time to respond to the consultation memorandum. There were also examples of the consultation note being sent to the wrong authority. The Norwegian Pollution Control Authority was listed as a recipient, despite the fact that it did not exist at the time, having changed its name to KLIF and merged with the Directorate for Nature Management to form the Norwegian Environment Agency.

The Norwegian Environment Agency was not listed as a recipient of the consultation memorandum. Neither was the Department of Environmental and Occupational Medicine at Oslo University Hospital included, despite the fact that it worked daily on mapping the health effects of non-ionizing radiation. Neither FELO (The Association for Electrosensitive Persons) nor Folkets strålevern (The People's Radiation Protection Association) were invited to submit a hearing opinion.⁹⁰ Criticism was raised that the hearing had not been sufficiently publicised. Criticism was also raised against the fact that the Norwegian Radiation Protection Authority had not kept up with the state of knowledge existing internationally from independent research into non-ionizing radiation. The criticism also concerned the allegedly artificial distinction between ionizing and non-ionizing radiation, as both forms of electromagnetic fields can produce long-term effects of the same kind (leukaemia, changes in cells' production of oxygen and oxidants). In the consultation letter from The People's Radiation Protection Association, a number of research results were shown which documented environmental threats from non-ionizing radiation.

FELO criticised the proposal to abandon the ALARA principle (as low as reasonably achievable) in favour of a principle stating that non-ionizing radiation should be kept as low as good practice

88 [Source absent in original]

89 See e.g. letter from the Norwegian Radiation Protection Authority of 29.4.2015 to Steenstrup Stordrange DA (ref. 15/00224/301)

90 These nevertheless issued their own consultation opinions.

dictates. In the consultation letter, the change had been justified by the claim that the ALARA principle being no longer professionally justified.

As stated above, errors or deficiencies in the processing of a regulation can result in the regulation being declared invalid. The duty to investigate regulations (Section 37 subsection 1 of the Administration Act) is assumed to have little independent significance for regulations.⁹¹ In legal theory, it is assumed that the regulation cannot be invalidated on the grounds that the case is poorly informed, as long as the regulation has been adopted by a competent authority and its content is in order. There is also no requirement that the authority which prepares the regulation considers all proposals or suggestions made in consultation letters. The fact that the authorities do not take all the consultation comments into account does not, of course, mean that the regulation becomes invalid.

There is also a requirement that interest groups whose interests are particularly affected, must be given the opportunity to express their views (section 37 second paragraph of the Public Administration Act). This requirement for the proceedings should, among other purposes, help to democratise the decision-making processes. It is also possible to submit the case (the proposed regulation change) to interest groups that have no formal organisation and to individuals. The purpose is to have the case fully informed (see section 37 second paragraph of the Public Administration Act).

It is not clear from the case documents to which we have been given access, why the Norwegian Radiation Protection Authority did not include FELO, the People's Radiation Protection Association and other potential stakeholders named above as consultation bodies. It appears obvious that the removal of the ALARA principle was controversial or could lead to debate about controls to safeguard the precautionary principle. It was also well known that there was considerable scientific material on the adverse health effects of low electromagnetic fields that the authorities should take into account when deciding to change the regulations. According to the terms of reference applicable to the regulatory change, the consultation period should normally be three months.⁹²

It is not clear from the documents we have had access to, why the Norwegian Radiation Protection Authority chose to send out a consultation letter on 20 June with a response deadline of 20 September. Against the backdrop of holiday closures for many of the consultation bodies, it can be assumed that this gave the recipients an actual response deadline of just over a month.

However, based on the weight normally attributed to the mentioned errors or deficiencies, our conclusion is that in connection with the preparation of the Radiation Protection Regulations, it is unlikely that there are errors or deficiencies in the case processing that could lead a court to conclude that the regulations are invalid.

4.10 Pollution

Questions have been raised in various contexts as to whether the Pollution Act (Forurensningsloven) sets any guidelines on the use of electromagnetic radiation, including whether electromagnetic radiation should be considered pollution.

The Pollution Act has the following purposes (Section 1):

“The purpose of this Act is to protect the external environment against pollution and to reduce existing pollution, to reduce the amount of waste and to promote better treatment of waste.

The Act must ensure a sound environmental quality, so that pollution and waste do not

91 Torstein Eckhoff and Eivind Smith in Administrative Law (9th edition).

92 The investigation instructions section 5.2 on <https://www.regjeringen.no/no/dokumenter/instruks-om-utredning-av-statlige-tiltak-utredningsinstruksen/id2476518/>

cause damage to health, interfere with well-being or damage nature's ability to produce and self-renew."

It follows from Section 6 of the Pollution Act that light and other radiation must be considered pollution to the extent determined by the pollution authority. The provision is to be understood as meaning that it is up to the authority (KLD) to decide that light and other radiation shall be included in the definition of pollution. As far as we can see, it has not been determined that electromagnetic radiation is to be covered by the term pollution. However, this field is legally regulated by the Radiation Protection Act, see chapter 4.3 above.

4.11 The Product Control Act

The Act on Control of Products and Consumer Services (the Product Control Act/Produktkontrollloven) aims to prevent products from causing health damage or environmental disturbances. The Act establishes a duty for anyone who produces, introduces, trades, uses or otherwise processes a product that may cause health damage, to exercise care and take reasonable measures to prevent and limit such effects, cf. Section 3. The Act is applicable to the smart meters that the grid companies install.

The criteria for assessing the safety of products appear in Section 3b. The meters will be considered safe if they are in accordance with a national standard that meets the requirements of the harmonised standard (harmonised standards drawn up within the EU system), cf. first paragraph. If no such standard exists, a broader assessment must be made, based on the provision's second paragraph.

We cannot see that there are circumstances which mean that the smart meters should be considered unsafe in relation to the Product Control Act.

The Product Control Act is a distinct "mandate act" which gives relatively broad powers for the respective administration to regulate product safety more closely, and to make decisions in specific cases. In addition to Section 3 (duty of care) and Section 6b (duty to report), the law itself only imposes legal obligations on the individual actor to a modest extent.

It is nevertheless key to note that the law, under specific conditions, grants everyone the right to information about products supplied by public bodies, as well as the right to information about products from the manufacturer, importer, processor, marketer or user of the product, cf. Sections 9 and 10. Such information can help to further clarify how the various meters work, and thus also what health risks they potentially and actually generate.

4.12 The Product Liability Act

Assuming that the technology used in the smart meters installed in Norway poses a risk of health damage, liability for damages may arise for the manufacturer and/or importer of the product.

The Product Liability Act requires a manufacturer or importer to compensate for damage caused by their product. It is a condition for liability that the damage is due to (is causally related to) the product not offering the safety that a user or the public could reasonably expect ("lack of safety"), cf. Section 2-1. When assessing the safety that could be expected, all factors related to the product, its presentation, marketing and foreseeable use are taken into account.

For there to be a basis for compensation, damage must have occurred, cf. Section 2-1. Where a health injury has occurred to a person, compensation must be assessed according to the rules in the Act on Compensation for Damages (Compensation for Damages Act) Section 3-1, cf. Product Liability Act Section 2-5.

A prerequisite for liability will be that it is possible to provide evidence that there is a causal link between the smart meter and the health damage in question, and the user had no rational reason to expect this based on the information and marketing that was available about the product.

4.13 Risk and strict liability according to non-statutory compensation rules

Under Norwegian law, a general, non-statutory objective liability for damages applies. The basis for liability has been developed through, and anchored in, legal practice. It is activated when an injury is caused by an extraordinary, typical and constant risk. Whether liability should be imposed depends on a broad balancing of interests. The Supreme Court has stated that an overall assessment must take place, where considerations should be taken, both to the parties in the relevant case and to the more general interests of a societal nature.⁹³

In addition to the basis of liability (strict liability in those cases where the tortfeasor bears the risk) it is also required that it has been proven to be a foreseeable causal connection between the financial loss that has occurred and the basis of liability or the risk that caused the financial loss.

In a case where the person considering themselves exposed to adverse health effects as a result of smart meters demands compensation for financial loss, the requirement for proof is that the person concerned must prove, with a preponderance of evidence, that it is the smart meter that is the cause of the financial loss.

Economic loss in this connection can be the costs associated with making changes to the smart meter installation resulting in the adverse effects being reduced. But other financial losses may also be relevant. In the extreme, the person in question may become ill and lose income, for example because the person in question is no longer able to work at the workplace where smart meters are installed. In order to have all or part of the financial loss covered, it must be proven that it is the negative effects of smart meters that caused the loss. In reality, this means that the person in question must provide evidence that smart meters have caused the adverse health effects.

We have identified examples of court decisions in Europe where the court found that electromagnetic fields were the cause of the damage and financial loss. Court decisions for national courts outside Norway normally have little or no direct legal source value, apart from the fact that they serve as examples and inspirational material for fact-based deliberations and considerations.

4.14 Other legal rules with references to regulations for the consequences of the radio communications technology used by smart meters

In addition to the legal rules that are particularly highlighted above, there are a number of other laws and regulations having a full or partial connection with the problems posed by the communications technology used by Norwegian smart meters, without in themselves constituting an independent legal basis for uninstallation, or in other ways establish effective legal mechanisms that the end users can use as a tool to reduce the adverse effects of the communications technology in the AMS meters. For the sake of overview, some of these laws and regulations are listed below, without the content of the individual provisions being dealt with in more detail. The review is not exhaustive.

The purpose of the Electronic Communications Act is to ensure good, affordable and forward-looking electronic communication services for users throughout the country, through

93 cf. Rt. 2003 p. 1546, section 65

efficient use of society's resources by facilitating sustainable competition, as well as stimulating business development and innovation, cf. Section 1.

Chapter 6 of the Act provides further provisions on frequency spectrum management etc. It follows from Section 6-2 that frequencies in the electromagnetic frequency spectrum cannot be used without permission from the authority. The authority can further attach conditions to permits for the use of frequencies in the electromagnetic frequency spectrum, including conditions on technical and operational conditions to avoid harmful interference and to limit the risk of electromagnetic radiation, cf. Section 6-3 no. 4. Pursuant to the law, more detailed provisions on the use of different frequencies, for example; in regulations for general permits for the use of frequencies (the Free Use Regulations).

Regulations on systematic health, environmental and safety work in enterprises (the Internal Control Regulations) aim to promote systematic improvement work within health, safety and the environment (HSE), prevention of environmental disturbances from products or consumer services and protection of the external environment against pollution, see Section 1. The provision is aimed at businesses that are covered by the Working Environment Act (Arbeidsmiljøloven), cf. Section 2.

The Working Environment Act establishes a number of requirements for health and safety in the workplace, including minimum requirements for safety and health for workers who are exposed to risk due to electromagnetic radiation. A number of regulations have been adopted based on the law which specify the obligations, including regulations on the design and layout of workplaces and work premises (the Workplace Regulations), regulations on administrative arrangements within the area of the Working Environment Act and regulations on organisation, management and participation.

The Act on Supervision of Electrical Installations and Electrical Equipment (EI-tilsynsloven) and regulations on electrical equipment establish as a basic safety requirement that electrical equipment must be designed and manufactured so that no radiation can occur that can cause damage.

Regulations on environmentally-oriented health care are issued on the basis of the Public Health Act (Folkehelseloven), the purpose of which is to promote public health and contribute to good environmental conditions, cf. Section 1. Furthermore, in the purpose provision it is stated that the purpose of the regulations is also to protect the population against factors in the environment, including biological, chemical, physical and social, which can have a negative impact on health.

The Planning and Construction Act (Plan- og bygningsloven) contains rules on land use and building applications. It is the purpose of the law that planning and decisions must ensure transparency, predictability and participation for all affected interests and authorities. Emphasis must be placed on long-term solutions, and consequences for the environment and society must be described, cf. Section 1-1 fourth paragraph. The Act provides further provisions that consideration of the environment and society is taken into account during the preparation of plans and measures, and when a decision is made as to whether and under what conditions plans or measures can be carried out. The provisions are specified in more detail in, among others in regard to regulation on impact assessments. Risk for radiation and risk for the population's health are central elements in the assessments and considerations that must be carried out in the processes laid down by the law, for example in spatial planning.

The Act does not provide any provisions that directly regulate the use of smart electricity meters in the individual households, but provides more guidance on the establishment of other structures as necessary to operate the AMS system, such as the establishment of communication hubs and base stations to which the individual meters communicate.

A number of authorities are responsible for ensuring that environmental requirements are met in Norway. These include the NVE, the municipalities in connection with building permit processing,

the Norwegian Environment Agency, the Public Health Agency (kindergartens, schools and homes) and NKOM.

5. Recommendations and any legal measures that may be relevant to individuals

5.1 Introduction

This section summarises any relevant legal issues and measures that may be recommended to individuals/end users. The summary specifically aims to answer the questions that appear below.

5.2 What can individuals do?

People who experience problems related to smart meters in their own homes can apply to the electricity supplier for an exemption. In this context, see the explanation of the end users' legal right to object to the installation of smart meters in point 4.6 above, as well as the explanation of what should emerge from the application in point 5.3 below.

People who experience negative effects from smart meters installed by third parties, e.g., neighbours, have few legal means to resort to. As explained in point 4.7, neither the contractual relationship with the electricity supplier nor neighbourhood law rules provide a basis for demanding uninstallation by third parties.

It is consistently assumed in administrative practice that this also applies in cases where the third party wants uninstallation, for the benefit of the person concerned. As appears in chapter 4 above, however, we believe that it can be further questioned whether this practice is based on a correct legal concept.

In order to get a final clarification on the question, it is probably necessary to test the validity of an administrative decision based on this legal opinion, by bringing it before the court, see chapter 4 above. However, this is an expensive process, and therefore not relevant for the ordinary end user, unless the lawsuit can be financed by a third party or the like.

5.3 What should be stated in an application for exemption from installation of a smart meter?

It must appear from the application that the AMS meter is a significant disadvantage for the applicant, and that the disadvantage is of a health nature. Below is a concise example of an application text:

“I hereby apply for an exemption for the installation of an AMS meter in my residence, because I/a member of the household has health problems that are causally related to the meter. The ailments are of such a nature that they are a significant impairment for me/a member of the household. Reference is made in this respect to the attached doctor's report.”

The application must be substantiated with documentation. This is done by presenting a certificate from an authorised healthcare professional. In practice, this will be a doctor.

Below is what should appear in the documentation attached to the application for exemption, in the three different types of cases mentioned in chapter 4.7 above:

Typical cases	Suggestions for what should appear in the documentation issued by authorized healthcare personnel
1. The end user experiences negative physical or mental health consequences from an already installed smart meter.	“It is the undersigned's professional assessment that the patient has health problems that are in a causal relationship with a smart meter (AMS) installed at their residence. The ailments are of such a nature that, from a health perspective, they are a significant impairment for the patient.”
2. The end user has a history of electro-hypersensitivity and for this reason reasonably expects that installation of the smart meter will have adverse health consequences.	“On the basis of the patient's history, it is the undersigned's professional opinion that the installation of a smart meter at the patient's place of residence may cause or intensify the patient's health problems, and thus be a significant impairment for the patient.”
3. The end user neither experiences nor has experienced negative health consequences from electromagnetic radiation in the past, but does not want to be exposed to the electromagnetic radiation, based on a risk consideration.	From a legal point of view, the typical case does not give rise to a claim for exemption. If it is the doctor's professional assessment that the fear of being exposed to the radiation is so extensive that it results in health problems for the patient, the patient will fall under type 1, and a certificate can be issued in line with the proposal above.

In a refusal of an application for an exemption for the installation of a smart meter, information must appear on how the refusal can be appealed. It is possible to appeal the refusal to the higher administrative body, and also depending on the circumstances to bring the decision before the courts.

[Added 2023 by Einar Flydal: The Norwegian Public Health Directory later issued a statement forbidding doctors to state that a patient could be ill from radiation from a smart meter, as such a statement would be in conflict with the health authority's view on the health risks associated with microwave exposure. It also warned medical doctors that statements should be based on examination of the patient and a professional medical opinion.]

Attachments:

Annexe by Einar Flydal on the risk of health effects from smart meters.

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Part 2: The Annexe

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Einar Flydal:

Meters, science, exposure limits and radiation protection

2nd Edition

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Preface to this Annexe

This annexe started out as an annotated collection of links to support my explanations to the lawyers about what is referred to in legal jargon as *the facts of the case*. However, it grew into becoming a comprehensive document that is now attached as an annexe to the legal report and is addressed to a much larger audience.

The aim is the same: to show through clear evidence that *there is overwhelming scientific proof of significant adverse effects* – both acute and long-term – on public health and the environment from the kind of microwave radiation we are exposed to from AMS/smart meters – even at exposures that are lower than the current limits.

Furthermore, it will be demonstrated that *such radiation causes health problems and increased health risks for people and the environment in ways that make today's limits – not completely, but to a large extent – irrelevant*, and that this has been known for a very long time.

Against this background, the introduction of AMS/smart meters shows that our current radiation protection regime is failing. There are several reasons for this failure. Some of the reasons are obvious, others more difficult to substantiate.

In this annexe, emphasis is placed on

- making the biological, health and technical aspects of AMS/smart meters sufficiently understandable,
- explaining how limits suggested by our Radiation protection agency (now named DSA) and the so-called knowledge base were created and maintained,
- showing how false it is when our health authorities claim that the "body of knowledge as a whole" does not find health problems and increased health risks from exposure below the current radiation limits, and
- showing that today's limits result in well-documented and demonstrable damage to our health and our living environment – and are already doing so already as acute problems arise in connection with the ongoing roll-out of AMS/smart meters and that more such damage is foreseeable in the future.

This annexe thus claims that the radiation protection authorities do not have science on their side, but against them, *and that the authorities and the industry have based their assessments on incorrect and inadequate information*.

This annexe's assessments, which follow from the material presented, are thus contrary to the view claimed by the Norwegian Radiation Protection Authority – where arrows point to in the Norwegian administration. The Directorate of Health, NVE, OED and the power grid companies all repeat the Norwegian Radiation Protection Authority's assessments and assure us that the radiation from AMS/smart meters is not problematic.

The purpose of the annexe is not to provide an exhaustive account, but to convey what is necessary for understanding both the broad and essential principles and the necessary small details – in a factually correct and comprehensible manner.

The lawyers, Advokatfirmaet Erling Grimstad AS, have of course been free to use the many drafts that emerged along the way to make their own assessments and to bring in and use other sources with different opinions. Without such freedom, their report would not have legitimacy.

The annexe has been constantly extended as the research project turned into a book project. It is one of the uncertainties of the project that some of the lawyers' assessments could have been different if

the lawyers had also read the very latest version of this annexe. As the annexe now stands, it is also an independent document on health aspects of AMS/smart meters.

Neither "Stop the smart meters!" or other organisations have been involved in the compilation process. The undersigned does not hold a position in any organisation with a stake in the matter and will not receive any income from the publication. Any profits from the sale of the book version will be used to disseminate the report, or to fund a new project.

Several people have helped to shed light on the case, as the lawyers would say. In particular, I would like to thank; librarian Ingrid Wreden Kåss for her thorough work with sources and research summaries over several years; civil engineer Jostein Ravndal, *both for his detection of errors in the Radiation Protection Agency's comparisons of emissions, and for his interesting calculations on exposure in wooden houses* from AMS/smart meters; radio amateur Arnfinn Kaaby for his assistance with harmonic frequencies; Jørgen Holst for documentation about *AMS court cases* around the world, and ICT engineers Odd Magne Hjortland and Marcel Honsbeek for measurements, explanations and discussions. Many others from whom I have learned a lot, e.g., about pulses and biological effects, should also have been mentioned. Some I know dare not be mentioned.

It has been particularly important to have contact with people who become acutely ill. It makes a huge impression and contributes to understanding: When people's reactions repeatedly strike completely unexpectedly, but fit with science they do not know exist and fit well when doctors' observations confirm the reactions, we have to believe that the evidence is right and that it is the health authorities' knowledge that is wrong.

The document was created within a few weeks in May-June 2018. Creating such a comprehensive document within such a time-frame would not have been possible without preparation and assistance.

The topic has followed me like a faint shadow for a number of years, but it was only in 2013, a couple of years after I left my position as a senior advisor for the Telenor group's research unit and a teaching position at NTNU in 2011, that it really started. Since then, I have read specialist literature about the topic, travelled and talked to scientific researchers, and disseminated the research in my blog posts and articles. I have drawn on this work now, and reference is made to several of these texts for further explanations instead of just referring directly to research articles, which are inaccessible to most people. This is a deliberate choice. Those wanting primary sources of information where I refer to my own blog posts will find them there.

An early draft of the document has been commented on by a reference group consisting of an electronics engineer, an environmental consultant, a librarian, three medical doctors and a lawyer – all with in-depth knowledge of different aspects of this highly interdisciplinary subject. A couple of the members of the group have requested anonymity. The entire group is therefore kept anonymous.

The reference group is thanked for its assistance, but the responsibility for the content rests entirely with the author, who is not even an expert in this area. But it seems that there are no single experts, as this topic spans so many different subjects.

My advice to the reader is not to be fooled by the chapter headings: They show a thread through the annexe, but here there are plenty of side tracks and detours in most chapters. These are necessary to tie together such a broad theme. Repetitions due to my own lack of overview may prove useful.

Einar Flydal, 4 July 2018

Note to the 2nd edition: *A number of small errors and wordings have been corrected. Chapter 2 has been given headings in the table of contents. In figures 12, 17 and 19 and in some places in the*

*text, notational errors have been corrected – without practical significance for the conclusions.
Footnotes have been improved.*

1. Introduction

To understand how radio communications from AMS meters affect biosystems – whether they are humans, animals or plants – we need to look far and wide:

Such meters have existed for such a short time that there is limited scientific evidence on their health effects. However, the meters use technology that is well known and understood to cause certain biological effects. These are *general effects of both low-frequency radiation and microwave radiation and have been studied over a long period of time*. Other effects and modes of interaction have been observed but are only partially known and poorly understood.

We need to look at both the technology and the biology. But even this is not enough: Parts of what we have to understand can only be understood in terms of bureaucratic/administrative and political stakeholder struggles. Therefore, this annexe is broad-based.

The telecom/ICT sector is four times larger than the pharmaceutical industry. It is increasingly based on microwave radio communication. Liberal exposure limits provide greater business potential. Microwave radio communication systems have become key infrastructure, both in civilian and military use. Key military systems, such as radar, are based on microwave radio technology. Hospitals make extensive use of microwaves. Modern utility systems depend on such communications. As consumers, we are all in daily contact with microwave technology. Thus, there are many strong stakeholder groups behind the technology, with large and sometimes diverging interests on the question of whether such radiation has harmful effects on health and the environment. As such effects are detected, it is all the more important to limit its use whenever the harm is not outweighed by the benefit.

There are *exposure limits* for non-ionizing radiation, to which microwaves belong, to protect us. These limits have a very short history as the first national guidelines only came into place in the Soviet Union and the USA after the World War II.

When such radiation is strong enough, microwaves can heat and thus damage body tissue. When weak, it can have effects that may be both positive and negative depending on the context and circumstances that you rarely have control over, such as stimulating cell division, increasing oxidant production, or slowing down the rate of metabolism.

In the USA, the guidelines were aimed at preventing harmful heating of body tissue occurring, and have remained so. In the Soviet Union, the limits were also aimed at preventing harmful effects found at much lower exposure – which could not cause heating.

Figure 1 shows how dramatically different limits have been set in different countries. Norway's limits are the highest column.¹

Part of this document is to show that it is overwhelmingly well documented that significant harmful effects on public health and the environment occur from microwave radiation at "sub-thermal levels" – i.e. weaker exposure (lower radiated power) than that which can cause heating damage, and which is the basis for the highest column and the current radiation limits – both in Norway and in a majority of other countries which together account for about 50% of the world's population.

Contrary to popular belief, the limits practised by the Norwegian Radiation Protection Authority today are not the ones supported by science. They cannot be given a reasonable scientifically-based justification when viewed in the light of the current body of research that also demonstrates damage without heating.

1 Jamieson, Isaac: RF / Microwave Radiation Risk Awareness (Abridged Version), EMF:AV_RM0140721, Biosustainable Design, 2014, <http://biosustainabledesign.org/>

NB! In this figure, the measurement unit $\mu\text{W}/\text{cm}^2$ is used. Otherwise in the document, $\mu\text{W}/\text{m}^2$ is used. Add four zeros and you get the value in $\mu\text{W}/\text{m}^2$.

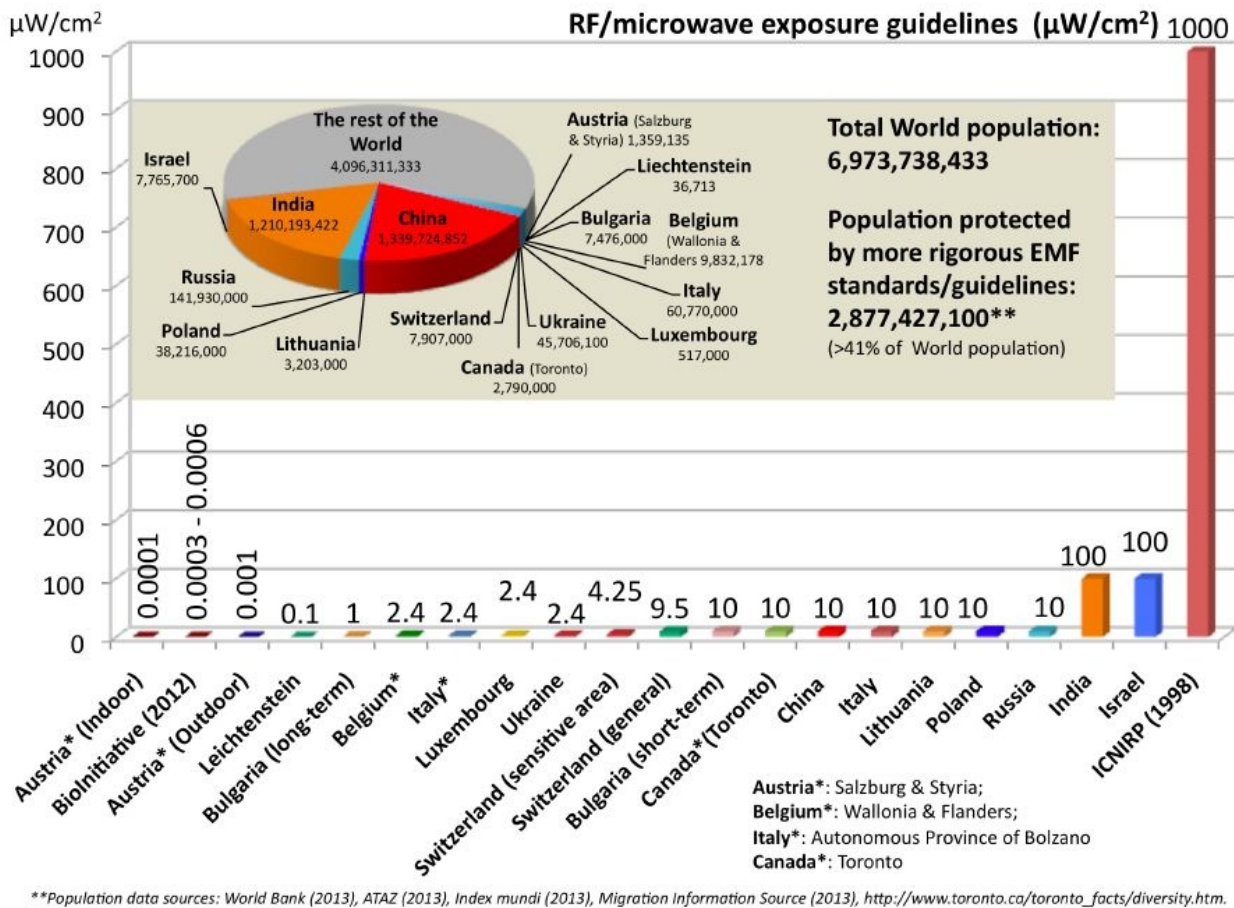


Figure 1: Limits in countries around the world and recommendations from the BioInitiative Group of scientists. Share of the world's population that has stricter limits than in ICNIRP (1998): approx. 41%

The Norwegian Radiation Protection Authority nevertheless defends both this "thermal principle" – or "thermal paradigm", and that the current limits are sufficient – for complex reasons that we will return to.

Exposure to radiation in the radio frequency range has increased over the last century relative to *natural background radiation* – the background level that life on Earth is designed to tolerate and exploit – to a level that is around 100,000,000,000,000,000 times higher.²

Total exposure in the microwave range approaches a total *energy density* ("irradiance") which is described by the same source as "full sunbathing – 24 hours a day". This is illustrated in Figure 2.

The two peaks around 1GHz, showing typical measured energy density (exposure) as of 2010, are very close to the ICNIRP's limits for the general population (bottom thick line).³ It approaches the energy density of full sunlight on a clear summer day, shown further to the right in the higher frequency range.

2 Philips, A. & Lamburn, G. (2012). Natural and Human-activity-generated Electromagnetic Fields on Earth <http://bemri.org/publications/natural-fields/427-natural-and-human-activity-generated-electromagnetic-fields-on-earth.html>

3 ICNIRP – The International Committee on Non-Ionizing Radiation Protection – is a German-registered self-owned foundation that has a rather unique position both as a supplier of guidelines to the UN system, and as a supplier of experts who participate in international and various national committees that review recent research to conclude whether changes in limits are needed. More about ICNIRP comes in later chapters.

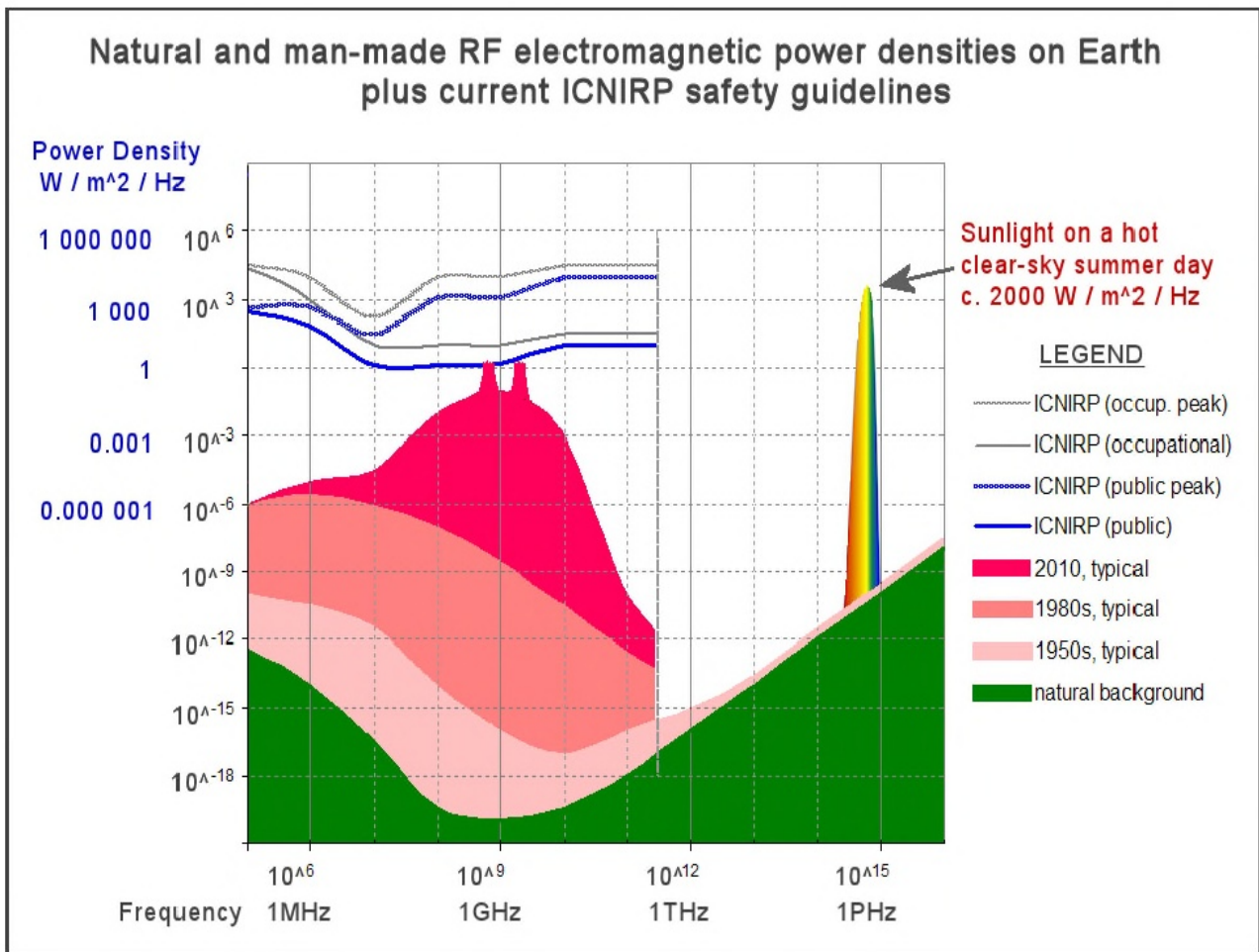


Figure 2: Man-made radiation – "near full sunlight"
(Philips & Lamburn 2012)

Sunlight has different frequencies and different biological effects than microwaves, but as the graph shows, natural background radiation in the microwave range is much lower than from sunlight. It has been much lower for as long as there has been life on Earth. Therefore, today's level is dramatically much higher, and the limits allow for it. On the other hand, we protect ourselves from sunlight when it is at its strongest.

Assuming it is correct that damage mechanisms are detected at exposure levels well below the current limits, this suggests that we should see an increase in objectively measurable, *substantially increased morbidity*. Furthermore, that we should see a *new morbidity pattern*, characterised by the type of damage that is typical of the mechanisms linked to electromagnetic fields. We should also be able to observe environmental damage.

As we will see, this is also the case. A number of scientific reports demonstrate this precisely.

But biology is a complex subject and research methods have their limitations. In addition, there are large and conflicting interests involved in interpreting such studies, and in contesting them. A great deal has been written on this topic.

1.1 The contrary perspective

In statements originating from the authorities and from the wireless industry, the authorities' and the industry's views, and the research and studies they rely on, are built up to constitute the dominant perspective – thereby setting the premises.

Sometimes it may be mentioned that there are opinions – and research – in opposition to this view, appearing as a kind of “alternative view”. This view is then given the burden of proof – the burden of having to demonstrate that its arguments and research are the best and "truest", and that the dominating views are wrong.

This process gives a very distorted view of the history of science and of the scientific knowledge within the area. In fact, the truth is the opposite: Research that finds harmful effects from exposures that are weaker than our limits has a clear majority and is the dominant view in medical research. An overview of published studies 1990-2017 (taken from the Medline research database) shows this clearly. See Figure 3 below, where grey bars show the percentage of reports finding significant associations between exposure and harmful effects, while white bars show the percentage of reports that did not find any such associations. Numbers in brackets show the number of reports.⁴

We see a clear majority of findings of harmful effects in all investigated areas.

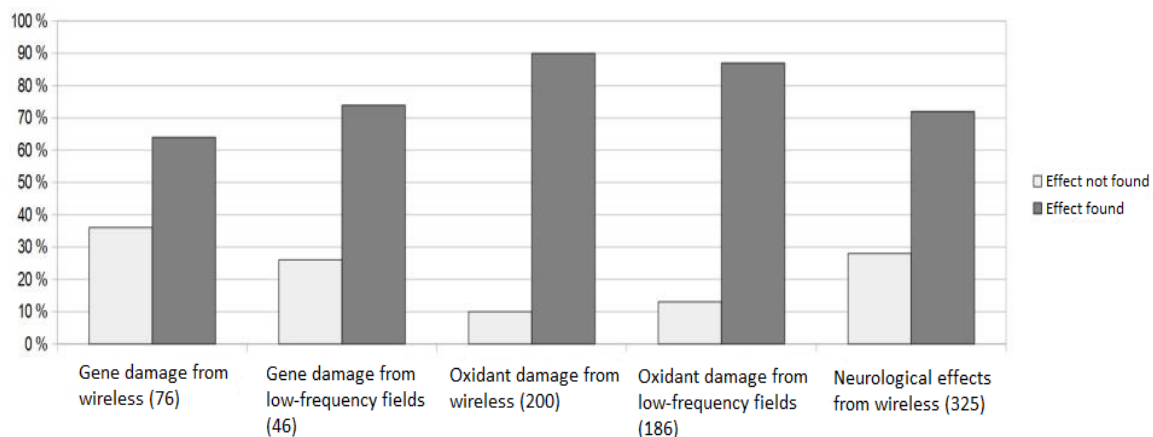


Figure 3: Clear majority of studies finding harm below the limits (Lai 2017)

This document therefore gives priority to the view of mainstream research before the view expressed by the authorities in charge of radiation policy. It also describes how "the thermal paradigm" arose, was allowed to take hold and is maintained.

This part of the book follows the following main structure, but with many exceptions and digressions:

- First, a number of key concepts are explained and put into context. This is followed by an introduction about AMS/smart meters. These sections also cover a number of non-technical topics needed for understanding the issues.
- Then follows a review of the scientific knowledge that constitutes the vast majority of research studies. Through solid and recognised studies, this research has found adverse

⁴ The graphs have been compiled by the author based on data in several documents by Henry Lai that were posted on <http://www.bioinitiative.org/research-summaries/> in December 2017.

health and environmental effects from exposure (far) below the current limits recommended by ICNIRP and hailed by e.g.; Norway.

- Next, the view is presented that such adverse effects have not been proven, or are too uncertain to be taken into account. This view is based essentially on the "thermal paradigm", a practical compromise from the 1950s that was intended to protect only against acute harmful heating of body tissue.
- Furthermore, it is described how the ICNIRP limits are based on studies that are designed so that they promote the "thermal paradigm". This is done through a scientifically weak process – to put it mildly. This is how the "knowledge base" referred to by the National Radiation Protection Authorities in “ICNIRP countries” and the USA is created.
- General biological properties of microwave technologies are described along the way and certain aspects that seem particularly relevant in the context of AMS/smart meters are discussed in some detail.
- A number of practical solutions are presented that may remove or reduce exposure from the microwave radiation caused by AMS/smart meters.
- Finally, a hypothesis is put forward and justified as to how AMS/smart meters will affect morbidity among humans and animals in Norway in the year 2022 and 10 – 15 years from now. This hypothesis will be verifiable.

2. The difficult chapter you may want to save for the end – Knowledge that makes understanding easier

Do you really know what to measure? Does a higher or lower measurement have practical significance for the health risk? What do the limits really tell about health risks? Is it true that we have always had radiation on Earth, so a little more or less doesn't matter? What is meant by ELF, RF and "thermal"?

This chapter explains and comments on a number of concepts and other things that are absolutely central to being able to assess information such as claims that radiation from AMS/smart meters and other microwave equipment is very weak, and what such statements actually mean. This makes it easier to understand what science has to tell and how measurement are performed. But unfortunately, it is not juicy stuff, and you would probably be more motivated for it after having read the other chapters...

Although this chapter is organised by topic, the topics intertwine and are not strictly structured either: The topics overlap and point to each other, and they anticipate later chapters – almost like Microsoft's thick user manuals in the 1980s: Each main chapter covered the same material, but from different angles, and that's useful.

Later chapters deal with the meters, the science and the history of how the limits were created and how they are maintained. When reading them, it will turn out to be very useful having read this chapter.

2.1 Concepts and keys to understanding

1 Exposure Limits in different countries and different recommended limits

Exposure limits indicate maximum values permitted or recommended for exposure from electromagnetic fields. Limits are set by the authorities, in Norway by the Norwegian Radiation Protection Authority. Guidelines proposed by ICNIRP are used as Norwegian limits (see footnote 3). They contain recommended reference values to protect against acute damage from heating.⁵ These are used unchanged, while many countries use ICNIRP's guidelines as a basis for stricter limits after assessing research and thereby the state of knowledge.

Today's limits for microwave radiation are measured by the amount of *energy received* – expressed as V/m or $\mu\text{W}/\text{m}^2$ – based on *the assumption that non-ionizing radiation in the radio frequency range can only cause damage by creating acute heating*.

The fact that this assumption is scientifically unfounded and has been so since before it was used as the basis for the limits, is discussed in another section, together with a description of the kind of forces and processes that support this assumption. Chapter 7 describes how this notion – "**the thermal paradigm**" – was established.

5 ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), Health Physics 74(4):494-522; 1998
Revision of the part that applies to low-frequency fields:
ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric And Magnetic Fields (1 Hz – 100 kHz), Health Physics 99(6):818-836; 2010, DOI: 10.1097/HP.0b013e3181f06c86
A revised version is on consultation in the summer of 2018, but based on the same "thermal principle". See review on einarflydal.com [blog post 31/07/2018](http://einarflydal.com/blog/post/31/07/2018)

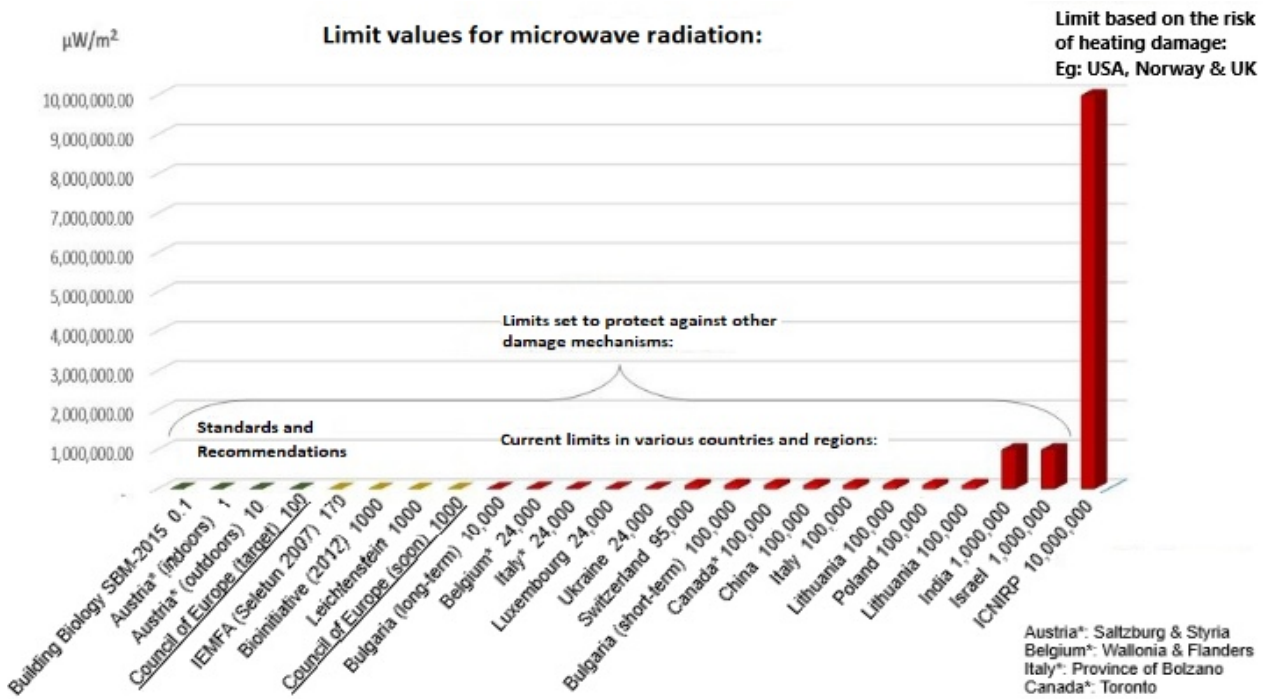


Figure 4: Limits in different countries and in recommendations (from Jamieson 2014)

The graph in Figure 4 above shows the limits in some countries for exposure to microwave radiation (at a frequency of approx. 1 GHz), and the recommendations made by certain organisations. In some countries, limits are set at the regional level.

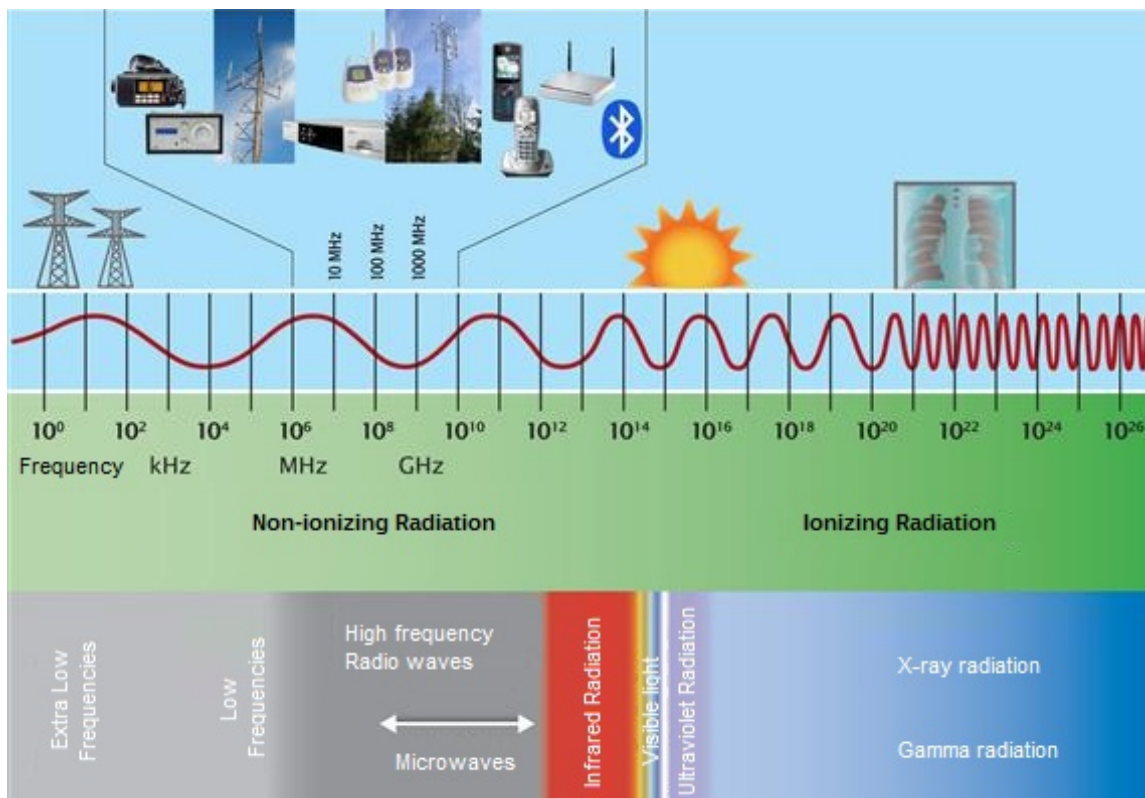


Figure 5: The electromagnetic spectrum (Figure from FHI 2012:3)

When referring to limits in general terms, the frequency 1GHz and the value of 10,000,000 $\mu\text{W}/\text{m}^2$ are used, although limits vary with frequency. One reason is that lower frequencies penetrate further into tissue and may "leave behind" more energy and thereby create more damage. It is good to know that lower limits apply to AMS meters: The limit for AMS/smart meters is therefore indeed stricter, but less exposure is needed when the frequency is lower to result in the same amount of damage.

The limits for AMS/smart meters are stated where relevant in the document.

The large difference in column heights reflects the differences in limits: The high column refers to the limit used by countries that follow the ICNIRP Foundation's "thermal-based" guidelines and use ICNIRP's *suggested reference values* for protection against *acute heating injuries also as limits for protection against other causes of damage and modes of injury – acute as well as as long-term injuries*. The rest of the countries are those that follow the mainstream view of the science, which is that significant harm occurs, acute as well as long-term, from exposures that are lower and related to properties of the radiation not captured by measuring power density. The radiation protection authorities in these countries have set much lower limits for their populations.

In Norway, ICNIRP's guidelines apply as guidelines where no other requirements have been set, and ICNIRP's *reference values* are interpreted as *limits*⁶ – that is, in Norway the high column applies. There is a consensus between Denmark, Sweden, Iceland and Norway to stick to identical same limits.⁷

Some countries, such as Switzerland and Italy, use ICNIRP's guidelines as a starting point, but set stricter national limits based on their own scientific reviews.⁸

In comparison, after a review of evidence in 2011, the Council of Europe recommended to its member states a radiation limitation of a maximum of 1,000 $\mu\text{W}/\text{m}^2$ as an immediate measure and 100 $\mu\text{W}/\text{m}^2$ as a longer-term target.⁹

The gap in understanding between these two worlds – the one that makes ICNIRP's *reference values* into limits and the one that finds them far too high for health protection – is illustrated by the following statement from the now former researcher Lars Klæboe, in the Norwegian Radiation Protection Authority. We find it in various versions over time:

*“The countries [in the West] that have lowered the threshold value have done so for political reasons – noise, actions, concern, popularity?”*¹⁰

For countries that have set much lower limits after carrying out extensive research in the field for many decades, this must be a rather unheard of and downright insulting statement.¹¹

6 Norwegian Regulations on radiation protection and use of radiation (radiation protection regulations), FOR-2016-12-16-1659, § 6

7 Exposure from mobile phones, base stations and wireless networks A statement by the Nordic radiation safety authorities, 17.12.2013, <https://einarflydal.files.wordpress.com/2018/06/nordisk-c3b6verenskommelse-om-emf-policy-2013.pdf>

8 See appendix in Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Folkehelseinstituttet, 2012, download from <http://www.fhi.no/>

9 The potential dangers of electromagnetic fields and their effect on the environment, Resolution 1815 (2011), Parliamentary Assembly, Council of Europe,

10 Klæboe, Lars, The Norwegian Radiation Protection Authority: "Electromagnetic fields – management and health", lecture, 05/04/2011, Stavanger, <https://www.yumpu.com/en/document/read/5422246/elektromagnetiske-felt-forvaltning-og-helse-disposisjon>

11 See e.g. Presman, A.S.: Electromagnetic Fields and Life, Springer Science, 1970, with its very extensive bibliography of Soviet Russian research.

2 Limits for AMS/smart meters

AMS/smart meters use lower carrier frequencies, and hence the limits are lower. As the Norwegian Radiation Protection Authority applies the ICNIRP guidelines directly, in Norway the resulting recommended exposure limits for AMS/smart meters are:

AMS-Manufacturer	Frequency (MHz)	Power Density Limit ($\mu\text{W}/\text{m}^2$)
Kamstrup	444	2 220 000
Nuri, Aidon	870	4 350 000

Figure 6: Frequencies and limits for exposure to AMS/smart meters installed in Norway

3 Electromagnetic fields – EMF

The term *electromagnetic field* (EMF) covers electric and magnetic fields in the entire frequency range (spectrum) from zero to infinity. See Figure 5. The highest frequencies, including X-rays, are ionizing, i.e. they have such high energy that electrons are detached from their orbit around the atomic nucleus and emitted with such force that they can break apart atoms/molecules when colliding. Hence, such radiation is called ionizing.

In the *non-ionizing* part of the electromagnetic spectrum, one may roughly group the fields into extremely low frequencies (ELF), low frequencies (LF), radio frequency fields (RF), infrared radiation (IR), visible light and ultraviolet light. Electricity from the mains has a frequency of 50 Hz and is in the extremely low frequency range. Microwave ovens, mobile phones, FM and DAB radios and AMS meters emit radiation in the upper part of the radio frequency range, the so-called microwave range.

4 Frequency, watts and other relevant units of measurement

The radio frequency part of electromagnetic fields (referred to as RF fields) lies in the frequency range 3kHz – 300GHz.

5 Hertz / Hz

Frequencies are measured in Hertz (Hz), which indicates the number of oscillations per second.

For example, the *Schumann frequency*, which is continuously generated by lightning and affects the *circadian system* (the daily rhythm of organisms) is at 7.83Hz. Household current is 50Hz in Europe, 60Hz in the USA. The central nervous system in humans uses frequencies in the range 0 to over 300Hz. Collagen molecules, which are present in all membranes, are twisted so that they change their permeability at 4,000, 6,000, 8,000, 10,000, 12,000 and 28,000Hz. This can affect the metabolism. (More in section 4.2.6.)

The carrier wave, which is the baseline for radio communication, is referred to as the *carrier frequency*. By *modulating* the carrier frequency – i.e. varying the signal in certain ways – information can be encoded into the carrier frequency and transmitted as speech etc., i.e. as information to be decoded at the receiver, or used for technical purposes in the operation of the network, for example as fixed pulses used to control the time sharing between users of the available frequency band.

"Embedded" into the carrier frequency are therefore pulses (i.e. "particle bursts") that occur at fixed intervals for shorter and longer periods of time, thus transmitting energy that arrives at other frequencies – lower or higher – than the carrier frequency. This occurs as a result of *modulation*.

AMS/smart meters installed in Norway operate in the area specified by the Free Use Regulations: Aidon and Nuri send radio signals with a basic frequency, i.e. carrier wave, of 870 MHz, while Kamstrup uses a frequency of around 440 MHz. Today's mobile phones are in the range of 800 MHz (millions of Hz) to 2.6 GHz (billions of Hz).

For 5G, it is also planned to use much higher frequencies. In "inner" parts of the telecommunication networks and in military service, much higher frequencies are long since been in use. Also, most WiFi routers operate at above 5GHz.

6 Pulses and modulation

The information to be transmitted through the radio signals is encoded by various changes to the characteristics of the carrier frequency. This is called *modulation* or *modulating*. In modern microwave-based communication systems, this occurs through the use of complex and simultaneous changes in the signal's frequency, phase and intensity (i.e. strength or amplitude).

Radio transmissions using modern microwave technology are not continuous. The information is collected and transmitted in blocks of information, frequently named "bursts". When transmitting large amounts of information (e.g. video), the intervals between blocks will be very short, whereas for small amounts of information, such as the transmission of meter data from AMS meters or "beacon signals" to maintain the connection between the meters, the pauses, where no radio signals are transmitted, are considerably longer than the transmissions. "Long pauses" in this context may mean a few tenths of a second. "Short pauses" may be a few thousandths of a second to several minutes or hours.

In a 4G mobile system, the signals are split and transmitted on different frequencies in parallel. Such "frequency hopping" means that sometimes many frequencies are transmitted simultaneously, resulting in some signal peaks that are significantly stronger than the average signal strength – as shown in the figures below.

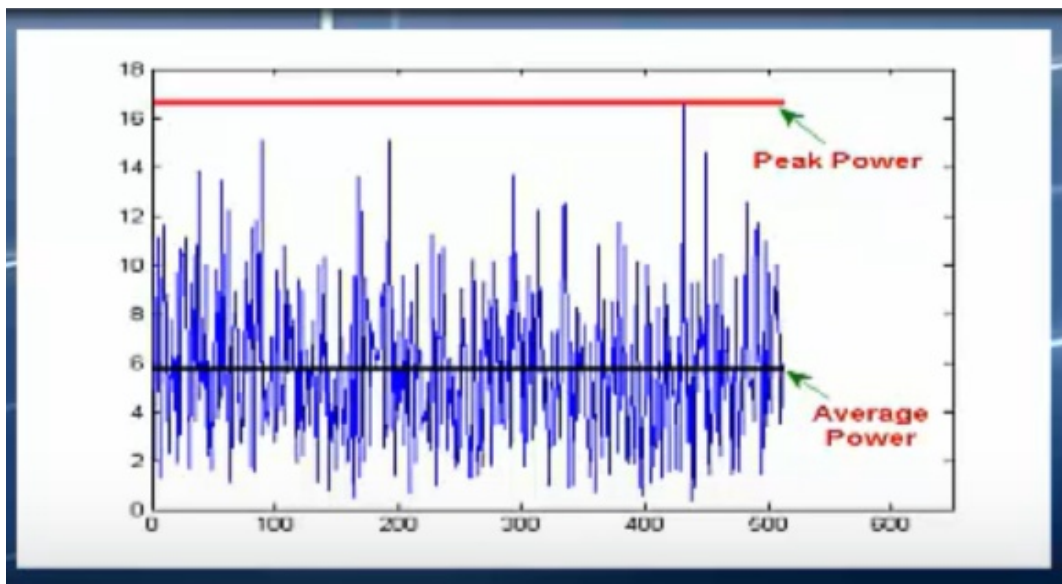


Figure 7: 4G mobile phone signal. Extra high peaks and pulses that rise above the carrier frequency are shown. They may form their own low frequencies.

Figure 7 shows an example of a 4G signal: The variations in signal strength lead to the formation of peaks that stick up. These will – more or less randomly and more or less continuously or enduring form independent, lower frequencies (ELF or LF) in the form of "bursts" or "pulses" or "shots".

Figure 8 shows a few seconds of the communication signal from an Aidon AMS/smart meter. It shows a series of pulses indicating that the AMS transmitter is active and emitting microwave radiation. When such pulses occur at more or less fixed intervals over a shorter or longer period of time, as in figures 7 and 8, these pulses form their own low frequencies (ELF or LF). AMS meters send such "pulse trains" all the time, around the clock. How often they do so varies by brand. It can be regulated by software.

By sending such signals around the clock, the wireless network between the meters is maintained, and error reports etc. can be generated that are useful for the operation of the network. However, it is not necessary for the collection of consumption data: These are collected continuously, but are only transferred once per hour (Aidon meters) or less frequently (every six hours from Kamstrup meters) and must only be delivered from the grid company to Norwegian authority NVE's clearing house (El-hub) once per day.

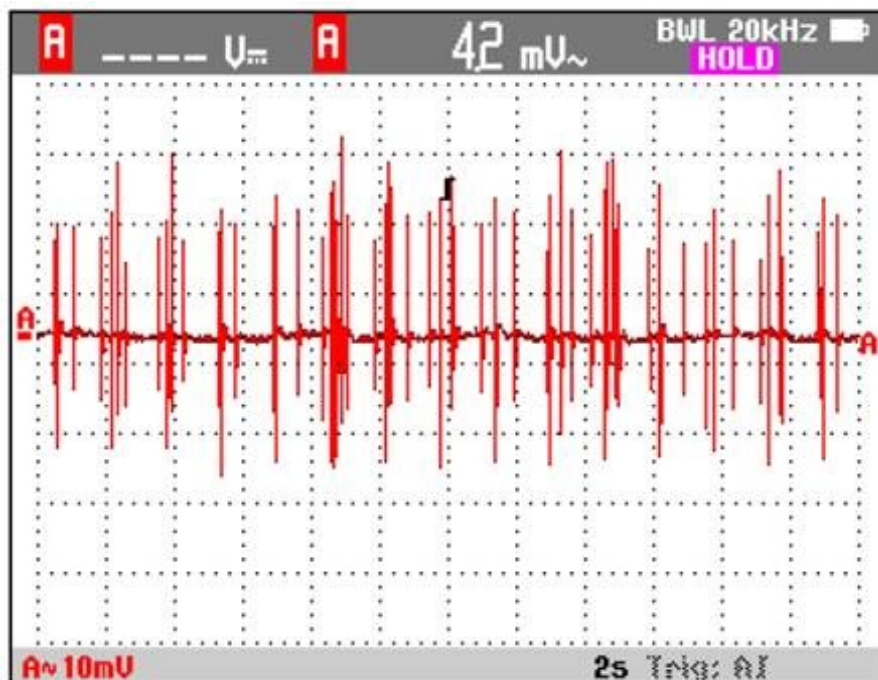


Figure 8: Sharp, high pulses over a much weaker carrier frequency (Aidon smart meter, image: EMF-Consult)

Low-frequency pulses embedded in the microwaves provide enough energy to disrupt biology

The current limits in Norway are based on an assumption that the carrier frequency of microwaves is too high and weak for it to have a biological effect – as long as the strength (*power density*) is not intense enough to cause heating.

But this is an assumption that is contradicted by scientific findings: Theoretical studies¹², practical studies^{13,14} and collective studies¹⁵ show that radiation from microwave transmitters, such as mobile phones and AMS/smart meters, has sufficient energy in the pulses to, for example, open cell

12 Panagopoulos DJ, Messini N, Karabarounis A, Philippetis AL, Margaritis LH (2000) A mechanism for action of oscillating electric fields on cells. *Biochem. Biophys Res Commun* 272: 634–640.

membrane calcium channels. This opens the way open for a wide range of biological reactions (which will be discussed later).

Today's limits for low frequencies (ELF and LF) are intended to protect against acute adverse biological effects. However, such adverse effects have long been well documented at much lower exposures.

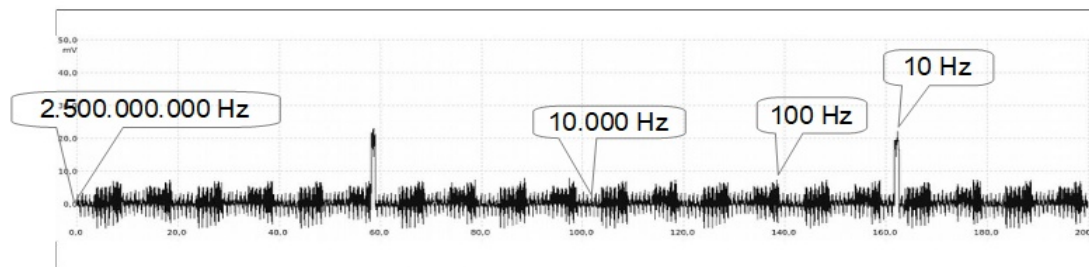


Figure 9: WiFi signal without traffic: Carrier frequency 2.5 GHz and several low frequencies (photo: Horsevad and Flydal)

In a microwave signal, low frequencies occur when shorter or longer series of pulses appear at fixed intervals, as in Figure 9, showing a WiFi router with no traffic. Here we see that the pulses form several low frequencies: 10 Hz, 100 Hz and 10 kHz.

Such low-frequency pulses alone may explain health-related reactions to microwaves. This will be explained in a later section on weather sickness and pulses.

These kinds of low frequencies that form in microwaves is a key feature of microwave communication. They have no heating capability unless the signal strength is far greater than we encounter in daily life. Nevertheless, our limits for microwave radiation are set on the basis of its heating potential. The low frequencies in microwave communication are not addressed by ICNIRP's guidelines, nor by the Norwegian Radiation Protection Authority.

"Weak" and "strong" and "rare" – What do these words really mean?

"In practice, the regulations are such that we have the freedom to do whatever we want."

This statement is a description made by a Norwegian industrialist about how the radiation from microwave communication equipment is regulated.¹⁶ He is one of several technologists from the ICT industry who have contacted us and expressed strong concern about the health effects of current microwave technology and its weak regulation on the part of public authorities:

Guidelines and measurement methods are formulated in such a way that they leave ample room for transmitting pulses that form low, biologically active frequencies. They can be transmitted at very high power – and still stay within the regulations and appear "weak" and "rare" in relation to limits and guidelines:

13 Panagopoulos, D. J., Chavdoula, E. D., Nezis, I. P., Margaritis, L. H.: Cell death induced by GSM 900-MHz and DCS 1800-MHz mobile telephony radiation, Mutation Research 626 (2007)= 69-78, online: <https://www.sciencedirect.com/science/article/abs/pii/S1383571806003202>

14 Yakymenko, I., Tsybulin, O., Sidorik, E., Henshel, D., Kyrylenko, O., Kyrylenko, S., 2015. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. Electromagn. Biol. Med. 35 (2), 186-202

15 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.

16 Statement from an anonymous source who works in microwave system development in conversation with the author, autumn 2016.

"Weak" versus "strong" non-ionizing radiation is defined in the radiation protection regulations¹⁷ as below versus above ICNIRP's guideline values respectively. All radiation that does not exceed ICNIRP's reference values is therefore "weak". In other words, the radiation must exceed a limit that was set to protect against damage from overheating for it to be considered "strong".

The regulation also defines "good practice" as staying within these same limits, which it takes quite a lot to break, at least as long as consumer electronics or normal distances from other transmitters are concerned.

*The Free Use Regulations*¹⁸ set, among other things, *time requirements* and *requirements for maximum transmission power* (output power) from metering equipment, which may be rolled out unlicensed as long as the regulations are followed. The signals from AMS meters stay within the requirements, but the requirements are technical and formulated in such a way that "rare" may well be so frequent that in a biological sense it is *continuous*:

Duration of communication: According to the Free Use Regulations, a single AMS transmitter may not use more than 2.5% of the 24 hour day. However, communication may well take place *every single second* if it only takes no more than the 2.5% of the day *in total*. This is easy to achieve if only the signals are short enough. The Aidon meters take advantage of this:

The transmission pattern of Aidon AMS meters has been measured to consist of pulses transmitted every 0.6 – 0.9 seconds, 24 hours per day everyday. Each pulse was measured at approximately 4 to 12 milliseconds. In addition, there is also communication when consumption data is transmitted, approximately once per hour. In any case, the total proportion of the day is well below 2.5%, despite the fact that the signal is continuous *24 hours a day* and forms a pulsation rate of 1 to 2Hz.

The strength of the pulses – i.e. the height of the vertical pulses in figures 7 to 9 – are, according to ICNIRP's guidelines that are by law authorised as regulations in Norway, allowed to have a power density ("strength") of 1,000 times the average power.¹⁹

At the same time, the Radiation Protection Regulations allow radiation to be briefly stronger than the ICNIRP guidelines indicate:²⁰

“In some situations, the limits in the guidelines from the International Commission for Protection against Non-Ionizing Radiation (ICNIRP) will be exceeded. For the general public, this is only acceptable for short duration exposure, for example when passing under power lines.”

If "short duration" is to be interpreted as it is in the Free Use Regulations, it means that one is free to develop solutions containing very short, powerful pulses that exceed ICNIRP's guideline values occurring intermittently but continuously, for example several times a second, but still only of "short duration", as aggregated over 24 hours.

This makes it understandable that some industry professionals are very happy with the freedom they have, while at the same time quite concerned.

17 Regulations on radiation protection and use of radiation (Strålevernforskriften),

<https://lovdata.no/dokument/SF/forskrift/2016-12-16-1659?q=strålevernforskriften>

18 Regulations on general permits for the use of frequencies (Fribuksforskriften), FOR-2012-01-19-77

19 ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), Health Physics 74(4):494-522; 1998, partially revised in ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric And Magnetic Fields (1 Hz – 100 kHz), Health Physics 99(6):818-836; 2010, DOI: 10.1097/HP.0b013e3181f06c86

20 ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), Health Physics 74(4):494-522; 1998, partially revised in ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric And Magnetic Fields (1 Hz – 100 kHz), Health Physics 99(6):818-836; 2010, DOI: 10.1097/HP.0b013e3181f06c86

7 Harmonic frequencies – a faint cacophony of unknown effects

From music, we know about harmonics: A single-stringed A is 440 Hz. Harmonics will automatically also be formed with frequencies that are multiples of A, i.e. with 880 Hz, 1,320 Hz, 1,760 Hz, 2,200 Hz, 2,640 Hz, 3,080 Hz and so on upwards. They will be weaker, and their relative strengths will determine timbre. (You can hear the harmonics change when you change the mouth cavity while singing a note.)

This is also the case – in principle – with the radiation from microwave transmitters: The frequencies emitted form harmonic frequencies. Here you see some of the harmonic frequencies created from the carrier frequencies of meters installed in Norway:

Aidon and Kaifa/Nuri transmit on 870 – 875 MHz, which we simplify to 870 MHz. Kamstrup transmits on 444.675 – 444.725 MHz, which we simplify to 444 MHz.

The harmonic frequencies created by the AMS meters will then be, among other things, the following frequency series (MHz), which in principle continues upwards to infinity:

Kamstrup:	444	888	1332	1776	2220	2664	3108
Aidon and Kaifa/Nuri:	870	1740	2610	3480	4350	5220	6090

Figure 10: Harmonic for AMS/smart meters (calculated)

In addition to these harmonics, there are the harmonic frequencies formed by fixed pulses, such as the "hello, here I am!" signals from Aidon meters every 0.8 seconds, and other more transient frequencies.

So is this a practical problem or just theory? I don't think anyone knows.

Harmonic frequencies are formed in all types of radio communications. That is why *filters* are added. These filters, called *low-pass filters*, are more or less effective. There are regulations to ensure that the filters are so effective that they do not interfere with other radio communications.

We are not aware of any analysis of the occurrence of such harmonic frequencies from AMS/smart meters. A certain amount of such noise will always be formed despite filters. What biological effects can be created and how much is needed to create them seems to be quite uncertain. Neither does it seem feasible to identify all the possibilities, e.g., for *interference* and *resonance*, or for other effects. Biological systems can be affected in so many ways. The section below about pulses causing weather sickness shows that even extremely weak signals can have significant biological effects.

AMS meters operate around the clock and do more or less often emit radiation around 3 times the intensity of 3G and 4G mobile phones (see separate point). The environment is thereby subjected to a weak cacophony of temporary patterns of frequencies – without us having any idea what effects their harmonics may have on biology.

If any effects had been sharp and clear, it would have been possible to identify the biologically active frequencies. If effects are diffuse, directed at basic biological functions, or work by their interference on each other, it is much more difficult. Empirical data, e.g., self-reported health problems having occurred after the meter was installed,²¹ may therefore be a better indicator of health risks than regulations and measurements.

For example, it was previously believed that such high frequencies as multiples of carrier frequencies for AMS communications could not have biological effects, but that notion has been

21 <https://einarflydal.com/smartmaler-historier/>

revised: It is now known, for an example, that E-coli bacteria communicate at such high frequencies.²²

The ICNIRP guidelines do not comment on harmonic frequencies. These guidelines are blind to them and to the fact that they may have biological effects. As they have a weaker power density than the fundamental tone, harmonics certainly do not affect the risk for overheating, but could possibly have other effects nonetheless.

In *PLC systems* (Power Line Communication – meters that communicate over the power grid) harmonic frequencies are created in a similar way to radio waves. This is an issue that has had less attention and is less strictly regulated, so the noise from harmonic frequencies may be substantial. When the wires are not shielded and the power high enough, the electrical wire will act as an antenna.

A small proportion of the AMS installations in Norway will be PLC systems. A bit more about PLC systems and *dirty electricity* is found in section 12.2.

8 Radiation

Radiation consists of *particle scattering* – and may alternatively be described as *waves*. Radiation from modern microwave radiation does not come as steady waves of a constant signal strength like waves in water, but as abrupt signals that vary in strength or as distinct "square pulses" (the particle stream is either fully off or fully on, and not gradually rising and falling as per water waves).

The carrier frequency – or what is called the *transmission frequency* – has a fairly low energy level that forms the output wave – *the carrier wave*. In Figures 7, 8 and 9 above, we see it as a slightly uneven baseline. The dissemination of information – whether for technical operation or content transmission – takes place through modulation (changes) of the carrier wave in shorter intervals (pulses, bursts of pulses, pulse trains). The modulation leads to strong variations in the strength of the signal, visible as the high points in the charts in figures 7 – 9. (See: 6. *Pulses and modulation*.)

Radiation that is strong enough to tear electrons from atoms is called ionizing radiation. X-rays and gamma rays are *ionizing* and are strong enough to tear electrons from the atoms to form ions.

Radio waves and longer wavelengths are defined as *non-ionizing*, meaning that they do not have enough energy to tear off electrons and thus change chemical bonds. However, the delimitation between ionizing and non-ionizing is in reality quite fluid, partly as bonds can be more or less strong. Furthermore, radiation may act indirectly, e.g., by opening calcium channels which initiate chemical processes, thus changing chemical bonds and creating ions.

Even radiation that is *non-ionizing* can have enough energy to set molecules into rapid oscillations, which by definition means creating heat. This is what happens in a standard microwave oven that most people have in their kitchen.

It is obvious and not disputed that *non-ionizing* radiation with energy so strong that it creates heat can also cause acute thermal injuries. This is not a matter for discussion. The question is whether there are harmful effects detected that arise *without acute thermal damage occurring*.

9 Thermal / The thermal paradigm

("heat-"/"heat-based", "sub-thermal level", etc.)

22 Soghomonyan D, Trchounian K, Trchounian A. Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?, *Appl Microbiol Biotechnol*. 2016 Jun;100(11):4761-71. doi: 10.1007/s00253-016-7538-0. Epub 2016 Apr 18, see <http://www.ncbi.nlm.nih.gov/pubmed/27087527?dopt=Abstract>

The "thermal paradigm" concept is central to the controversy within the field of radiation regarding health and environmental damage. The controversy revolves around whether it has been sufficiently well proven that health damage can occur at lower energy levels of radiation compared to what is needed to create acute heating and resulting damage mechanisms, and whether these findings should lead to stricter and different exposure limits.

And conversely, the issue is whether the proof of such health damage, as is indisputably demonstrated in the majority of research articles, is not be considered sufficiently well proven for it to be taken into account.

The issue here is therefore both how certain the research findings should be considered to be and how much certainty should be required before taking preventive action (a precautionary approach). The discussion is dealt with in detail later in the annexe.

The thermal paradigm has been refuted numerous times with convincing evidence. A wide range of mechanisms have been shown to operate at "sub-thermal" exposure levels.²³

You can do a simple – but perhaps harmful! – test yourself: Find an apartment block that has a common electricity meter room in the basement and has switched to AMS/smart meters. Take an EMF measuring device with you and go into the room and stay there for a few minutes. You will see on the measuring device that the exposure level is far below the ICNIRP reference values, used by the USA and Nordic countries also as recommended exposure limits. At the same time, you will probably feel groggy after some time. You shouldn't be if the thermal paradigm was valid and the limits protected you.

10 Exposure ("to be subjected to something")

Exposure is usually measured as the *radiated power*, i.e. the power density of the radiation – from one or more radiation sources – that hits the object, e.g., a person or that person's head. As today's limits only take into account *the thermal effect* of the radiation, exposure to EMF is thus measured as energy density (i.e. intensity), and evaluated against a limit that is set on the basis of how much it takes to heat water by one degree in six minutes.

In Europe, the unit commonly used to measure exposure in the radio frequency range is the *millionths of a Watt* (or micro-Watt) *per square meter*, $\mu\text{W}/\text{m}^2$. Hence, 1 μW is 0.000001 W. You also often come across mW, i.e. milliwatt, or thousandths of a Watt.

In US cities in the 1970s, exposure levels were assumed to be around 10 $\mu\text{W}/\text{m}^2$. It became an issue whether exposure above this level should be avoided. In today's urban environment, you will easily find exposures in the range of 2,000 to 80,000 $\mu\text{W}/\text{m}^2$.²⁴

The sources of radio frequency fields are primarily equipment used for radio communication (broadcasting, mobile telephony, WiFi, heart rate monitors, sensors, electrical noise from electrical machines, etc.). There is normally no danger of excessive heating from such sources – unless you are staying very close to them, say less than about 6 m from, e.g., a powerful mobile mast or broadcast antenna. However, "sub-thermal" methods of impact have been demonstrated, which will be discussed in a later section.

23 Horsevad, Kim: Mapping Bioreactivity for Microwaves in Non-thermal Intensities, Saxo, 2015, can be ordered from Akademika or downloaded here: http://helbredssikker-telekommunikation.dk/sites/default/files/Kortlaegning_af_Bioreaktivitet_ved_Mikroboelger_i_non-termiske_Intensiteter-2015.pdf

24 Lennart Hardell, Tarmo Koppel, Michael Carlberg, Mikko Ahonen and Lena Hedendahl: Radiofrequency radiation at Stockholm Central Railway Station in Sweden and some medical aspects on public exposure to RF fields, *International Journal Of Oncology* 49: 1315-1324, 2016

Exposure should be measured by *measuring the sum of all sources*. Simple measuring devices usually only capture the radiation from one direction, not from all directions plus they do not add up the sources, just register the strongest signal. They will therefore under-report the total exposure.

Since the measurement of power density alone may have very limited value as a measure of overall health risk, it is an important point that this measurement method should always be supplemented with other relevant information about other mechanisms, e.g., pulsation, when assessing exposure. (This is done in the EUROPAEM 2017 guidelines, which are discussed later, amongst others, in Section 5.2.)

A rule of thumb states that exposure to radio radiation decreases by a quarter for every doubling of the distance to the transmitter. For example; when 1,000 $\mu\text{W}/\text{m}^2$ is measured 3 metres from the radiation source, only 250 $\mu\text{W}/\text{m}^2$ is measured at 6 metres away and 62.5 $\mu\text{W}/\text{m}^2$ at 12 metres away from the source.

This rule is the basis for standard calculations of exposure.

11 Does the impact weaken when the power density of the radiation decreases?

Yes, this is the usual assumption on which current limits in USA, the Nordics and many other countries are based, and it obviously applies to a large extent, but it is by no means completely true. If the radiation's power density is reduced, it is by no means certain that its *biological effects* will be reduced:

For example; radiation may affect via *resonance*. Resonance occurs when hitting the *natural tone* and occurs even if the power is extremely low. The effects of resonance therefore changes less with distance or power density: Even extremely weak signals can cause resonance in biological units of various kinds.

Resonance appears to happen by atmospheric discharges in weather systems resulting in very specific frequencies (so-called *CD-Sferics*) that make people weather sick. They impact over a very long distance although causing extremely weak exposures. The same frequencies are found in microwave signals. See further discussion in a separate section under *electro-hypersensitivity* and in another section concerning *weather sickness*.

There are also "window effects" and other deviations from a simple linear and positive relationship between exposure and effect: It is therefore not always the case that the stronger the exposure, the greater the damage. It may even be the opposite.²⁵

12 Brillouin Precursors: The radiation that engineers didn't learn about

Ever since 1914, experts have known that the rule that the power drops to a quarter when the distance is doubled, does not apply in cases with very short wavelengths and strong pulsation. In such cases, the strength of the pulses can weaken much less with the distance because of a special phenomenon called Brillouin precursors:

*"... When an ordinary electromagnetic field enters the body, it causes charges to move and currents to flow through the body. But when extremely short electromagnetic pulses enter the body, something else happens: the moving charges themselves become little antennas that re-radiate the electromagnetic field and send it deeper into the body. These re-radiated waves are called "Brillouin precursors". They become significant when either the power or the phases of the waves change rapidly enough. ..."*²⁶

25 Alasdair and Jean Philips: Are we measuring the right things? (Windows, viewpoints and sensitivity), paper, undated, https://www.powerwatch.org.uk/library/downloads/measuring_right_things-20071028.pdf

26 Arthur Firstenberg: 5G – From Blankets to Projectiles, <http://cellphonetaskforce.org/5g-from-blankets-to-bullets/>

The frequencies used by the AMS/smart meters in Norway may be short enough to create Brillouin precursors if the pulses are abrupt and powerful,²⁷ but this has hardly been investigated.

There are a number of warnings about the harmful health effects of Brillouin precursors from scientists who have worked on military applications, such as long-range radars and radar that can see through water, tree canopies and other materials that absorb electromagnetic radiation. It is stressed by military scientists that the technology has not been tested for its biological effects, while there are reports that such radiation has triggered health problems for a number of people.²⁸ For example, they warn that the energy in Brillouin precursors can be large enough to create large enough voltage differences inside and outside the cell membranes to open ion channels in the membranes and disrupt cellular functioning. This is a well-documented mechanism that is discussed in several places in this annexe.

13 Watt (and micro-Watt – μW)

Watt is a unit of electrical power and is used as a yardstick when calculating or measuring the heating potential from radiated energy. If the supplied electric power is sufficiently large, heat generation will occur, even over a short time period.

Radiated (and received) energy flux is expressed as $\mu\text{W}/\text{m}^2$ (millionths of Watt per square metre).

Micro-Watts per square meter ($\mu\text{W}/\text{m}^2$) is an expression of the average amount of energy per square metre.

ICNIRP defines that when measuring exposures, the energy received should be averaged over a 6 or 30 minute period. This means that the exposure may be much stronger during parts of that period.

In many of its measurements, *NKOM* uses a more precautionary principle and measures the peak value of the signal. To be sure which value has been measured, one should check whether the measurement was averaged or not.

Watts are also expressed in milliwatts (mW) and micro-Watts (μW), and in the US per square centimetre ($\mu\text{W}/\text{cm}^2$) rather than per square metre.

With reference to ICNIRP's reference values, values between 4,000,000 and 10,000,000 $\mu\text{W}/\text{m}^2$ are recommended as the maximum in the USA, the Nordic countries, the UK and several more for frequencies used by mobile phones. The lower the frequency of the radiation, the lower the limit.

The Council of Europe's Parliamentary Assembly recommended in 2011, after a scientific review and for reasons of public health, a level of 1,000 $\mu\text{W}/\text{m}^2$ to be implemented urgently, and later to be reduced to 100 $\mu\text{W}/\text{m}^2$. There are other organisations that recommend even more restrictive recommendations.²⁹

14 SAR – (Specific Absorption Rate)

The *Specific Absorption Rate* (SAR – the value) is a measure of the speed at which energy from radiation is absorbed by a specific part of the human body – for example; the brain, blood, skin and muscles. The thinking behind SAR is based on the heating potential, i.e. the thermal paradigm, to avoid overheating.

The SAR metric is thus used for calculating/measuring the risk of heating damage from EMF. To measure SAR, different *average values* for the absorption capacity of different body tissues are

27 See e.g. "Brillouin Precursors 101 with Professor Kurt Oughstun" and several other articles in Microwave News March/April 2002,

28 See various articles in previous source. Microwave News March/April 2002.

29 See footnote 9

used: Measurements are made in trays filled with a liquid having the same heating properties as the respective body part is supposed to have – *on average*.

SAR is typically used for calculating health risks from mobile phones. The SAR value of 2W/kg is the limit that applies to a mobile phone held at the head, at approximately 2 cm distance.

SAR has been strongly criticised as an uninformative measurement method, based on very crude simplifications, and also based on the fact that heating, or other mechanisms that are closely correlated to heating, are the only important pathways for damage to occur.

SAR values are not used for AMS/smart meters.

15 Radiated power measuring systems – e.i.r.p. vs. e.r.p.

It was these two measuring methods that the Norwegian Radiation Protection Authority mixed up when it claimed in information material³⁰ that the radiation from AMS/smart meters *is much weaker* than the radiation from mobile phones.

If calculated correctly, you will find that the AMS/smart meters are *several times stronger* than today's mobile phones (3G and 4G). The Norwegian Radiation Protection Authority has since acknowledged the error in a letter, but as far as we know, no information has been released to NVE, grid/network companies or the public.³¹

There are two different measurement systems to indicate radiated power from a radio transmitter. These are used in standards and guidelines, but should be used consistently and not mixed. Both systems use mW or W as the unit of measurement. To distinguish between the two measurement systems, these terms are used:

- e.r.p. (equivalent radiated power)
- e.i.r.p. (equivalent isotropic radiated power)

Conversion factor from e.r.p. to e.i.r.p. is 1.64.

In the Free Use Regulations, which among other things, regulate the maximum permitted radiated power ("transmitting power") from AMS/smart meters, the maximum permitted radiated power is stated to be *500mW, measured according to the e.r.p. measurement*.

However, the maximum permitted radiated power from mobile phones, is stated by using e.i.r.p. This means that if we are to compare the radiated power from an AMS transmitter with a mobile phone, we must convert measurements to e.i.r.p. An AMS transmitter then has a radiated power of 820 mW. A 4G smartphone has a maximum radiated power of 250 mW e.i.r.p., i.e. less than a third of the AMS transmitter.

16 Interference

Interference means that one electrical system affects another. This happens, for example, when you hear noise from the mobile phone from a loudspeaker. Interference is a well-known electrical phenomenon.

30 Weak radiation from smart electricity meters, RADIATION PROTECTION INFO 09 17, Norwegian Radiation Protection Authority, 2017, https://dsa.no/publikasjoner/straleverninfo-9-2017-smarte-strommalere/Str%C3%A5levernInfo_09-17_Automatiske%20str%C3%B8mm%C3%A5lere.pdf or <https://einarflydal.files.wordpress.com/2018/06/straaleverninfo-09-2017-smarte-stroemmaalere.pdf>

31 For mention and relevant correspondence: [Flydal, E: Stråvernet admits: It has misinformed about the strength of the AMS meters](#) blog post 3.5. 2018 and [Flydal, E: "Smart" meters: Fake news from Stråvernet \[Norwegian Radiation Protection Authority\]](#), blog post, 24/08/2017

The human body and all other living matter contains a number of complex electrical systems as all chemistry has an electrical aspect. These systems are continuously exposed to *interference* from the environment as well as from other artificial (non-natural) sources of EMF, such as smart meters, TETRA (emergency networks), DAB radio, 3G, 4G, WiFi, etc.

Living beings are *complex, dynamic systems* that can cope with such stresses for a period of time. When the system does not manage any more, health problems develop. This can happen quite suddenly. The theory about such matters, was developed in particular by Hans Selye, under the name of *the theory of biological stress*.³²

In such cases, one often says *thresholds* have been exceeded.

The fact that biological systems will try to counteract stresses for a long time when they are exposed to interference means that short-term studies are generally unreliable when studying the effects of environmental stressors: Such studies should not end until the response appears, when the body is no longer able to counteract the impact. Many studies are short-term, and can therefore easily underestimate the potential impact.

17 Cocktail effect and threshold value

It is well-established knowledge that environmental pollutants (*environmental stressors*) can amplify each other's effects. This is referred to as the *cocktail effects* or *interaction effects*. For example, exposure to industrial chemicals can intensify the reaction to something you are allergic to, such as grass pollen.

A common model that is widely used in environmental medicine³³ shows a number of environmental stressors – including EMF, electromagnetic fields – that may interact (see top of figure 11), and thereafter they essentially have the same mechanisms of action internally in cells (middle of figure 11):

Many environmental toxins – including microwave radiation – act primarily by increasing or disturbing the production of oxidants (nitric oxide) inside cells, which then triggers a wide range of chemical processes that might become self-sustaining.³⁴ These include impaired energy production (ATP). Among the resulting effects are inflammation and a weakened immune system. A wide range of very different symptoms that seem completely unrelated to each other may then occur in the next stage.

Cocktail effects and the many different resulting symptoms make it difficult to sort out the causes in the individual cases. We are faced with a *many-to-many relationship* between causes and effects.

32 For more about Hans Selye and his research into biological stress, the cocktail effect and threshold values, see [Flydal, E.: What electro-hypersensitivity really is? I found the piece I was missing in Pest](#), blog post 24/10/2015

33 Here taken from the EUROPAEM 2016 guidelines, where it is explained in more detail: Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshhammer, 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. <https://www.degruyter.com/document/doi/10.1515/reveh-2016-0011/html>

34 Same source, and a number of sources given earlier.

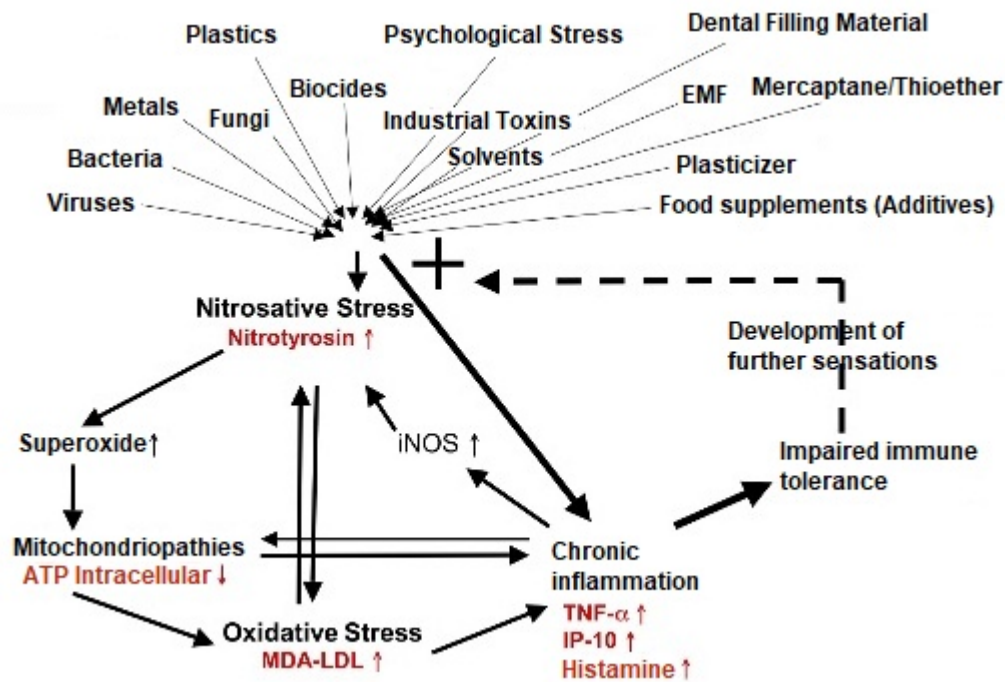


Figure 11: Common model to show the effects of environmental stressors on cellular processes and health effects (here from EUROPAEM 2016)

Environmental medicine practitioners address environmental stressors through a methodology that places *emphasis on identifying and removing the causal environmental factors*, while at the same time conducting conventional medical differential diagnostics to rule out other sources.³⁵ This is a methodology with which there is good experience.

Thresholds and trigger points refer to the fact that medical scientists have long observed that biological systems can often be exposed to a number of environmental stressors without having noticeable reactions, until one day they exceed some overall threshold and react with disease or health disorders. How high the doses have to be in order to exceed the thresholds, is often only visible in hindsight:

The originator of the theory of biological stress, the medic Hans Selye, understood from his patient interviews that once such a threshold had been crossed, and thus "the cup had spilled over", a new state of health had been triggered, where *the cocktail of various environmental stressors could sustain the reaction even at significantly lower exposures*.³⁶ The body tried to resist for a while, but eventually gave up.

If a person is initially exposed to a certain amount of radiation from various sources (WiFi, mobile phone, cooker, electrical system, etc.), even minor additional exposures, such as the installation of AMS/smart meters in the neighbourhood, might therefore be "the straw that breaks the camel's back".

35 A methodology statement from German and Austrian environmental medicine associations can be found translated here: Flydal, Einar: [Environmental Medicine: EMF is a real environmental poison](#), blog post 20.01.2016. The original is: Diagnostik umweltausgelöster Multisystemerkrankungen aus Sicht der Klinischen Umweltmedizin [Diagnosis of environmentally triggered multi-system diseases from the point of view of clinical environmental medicine], EUROPAEM 2012, <http://europaem.eu>

36 For a smart meter case, see Flydal, E: "Smart meters": It's the total that counts, blog post 12/09/2017.

There are many observations that *electro-hypersensitivity* can be created in such a way – i.e. by exceeding threshold values.³⁷ Subsequently, this person becomes hypersensitive and dependent on keeping the exposure to the environmental stressor low in order to avoid health-related problems.

Situations that follow this pattern seem to be observed in the Norwegian environment in connection with AMS/smart meters: Several self-descriptions indicate that quite a few people have become electrically hypersensitive for the first time shortly after installation and that the reactions persist thereafter, even when measurements show that the meters' transmission power is reduced after the running-in period.³⁸ In such cases, they even need to remove not only the transmissions from the AMS meter, but also sources that they previously did not react to, because they have now started to react to them. The AMS installation thus triggered the health problem, while the reactions are then triggered or maintained by these other sources.

Cocktail effects and thresholds therefore mean that, when introducing new environmental stressors, strategies must be in place to avoid exceeding threshold values. It is not an acceptable strategy to remove the environmental stressor *only after someone has become ill from the AMS meter and understands what is making them ill*.

It has been reported that some utility companies propose such a strategy for customers: – Install the new meter and we will come and take out the communications module if you become ill.³⁹

It follows from the environmental medicine framework that such a strategy followed in the AMS rollout is directly disease-inducing.

18 Always assess the overall exposure

It follows from the paragraphs above, you need to take account of *the total exposure* plus cocktail effects and that there are individual thresholds that should not be exceeded.

However, cocktail effects and thresholds also mean that there are no uniform formulae or scientific methods or assessment criteria that can provide the sole basis for risk assessments and limits.

Consequently, little is currently known about the overall biological impact of radio communication technologies in modern society and in principle, it is well beyond the scope of measurement. It is simply not known what to measure and how to link measurements to causes and effects in general. The picture is too complex and only fragments are studied.

It is clear that current day measurement methods fall short and must be taken with a pinch of salt. One is therefore at the mercy of supplementing the interpretation with analogies, with knowledge from laboratory tests on fruit flies, rats and mice, and from experience.

Epidemiological research can still give some indication of the overall environmental health burden. It shows clear signs of increasing – in ways that are fully consistent with the above model. The disease picture in the USA and the rest of the West has been turned upside down in the course of a single generation: Environmental illnesses now dominate, linked to increased oxidant production and inflammation.⁴⁰ The breakthrough in understanding the role of oxidants behind many of today's

37 E.g. Carpenter, David O.: Excessive Exposure to Radiofrequency Electromagnetic Fields May Cause the Development of Electrohypersensitivity, *Alternative Therapies*, Nov/Dec 2014 Vol. 20, 6, https://www.researchgate.net/publication/269184131_Excessive_Exposure_to_Radiofrequency_Electromagnetic_Fields_May_Cause_the_Development_of_Electrohypersensitivity

38 Flydal, Einar: [Smart meters transmit wildly in apartment blocks: - Now I've also become sensitive to the mobile phone!](#), blog post 20.03.2018

39 Emails sent to the undersigned, 2018.

40 This is discussed further in later parts. It is described a bit more fully in Flydal, Einar: "Electromagnetic radiation – are we gambling with our children's health?", article in the book *Critical views of the school* by Ole Briseid et al., Z-forlag, Oslo, 2018.

until recently "unexplained" disorders – more than 150 diagnoses and more than 60 chronic conditions – came around 2007.⁴¹

However, as Figure 11 above also shows, it is difficult to interpret from health statistics the contribution made by each individual pollutant. This also applies to the share of radiation. The environmental stressors partly work through the same mechanisms.

19 The authorities in Norway

The Norwegian Radiation Protection Authority is the regulatory authority for radiation protection in Norway – both for ionizing radiation and non-ionizing radiation. Non-ionizing radiation from microwave communications fills a very small part of the Norwegian Radiation Protection Authority's capacity.

The Norwegian Radiation Protection Authority's view on how strict the limits should be is based on ICNIRP's guidelines and on the "*knowledge base*" that emerges through *committee investigations*. These committee investigations follow *ICNIRP's guidelines* for evaluation methods when assessing research.⁴²

WHO's tiny office *The International EMF Project* promotes the ICNIRP guidelines worldwide. Norwegian policy in the area is often described as Norway "following the WHO".

The most recent report from such a committee set up on the initiative of the Norwegian authorities was published in 2012.⁴³ The committee behind the report is described elsewhere in this document as having created a strongly distorted "scientific base" by "screening out" of all relevant findings that challenge thermal-based limits. More about this in later sections, including 9.2.

NKOM – National Communications Authority: NKOM's role is to supervise those who provide postal and telecommunications services, to ensure they do so in accordance with applicable national and international regulations. NKOM is the responsible authority for frequency allocation and control, and carries out technical measurements of radiation levels. NKOM assesses radiation levels in accordance with current guidelines issued by the Norwegian Radiation Protection Authority, which means that *reference values* from ICNIRP's guidelines⁴⁴ to protect against damage from excessive heating apply in Norway as *recommended exposure limits*.⁴⁵

In many of its measurements, NKOM applies a *precautionary principle* by measuring the peak value of the signal – not *the average value* as suggested in the ICNIRP guidelines. In order to be sure whether it is a peak value or an average value that has been measured, one should therefore look for information on how the measurement was performed.

NKOM's measurement reports are of little value for assessing health risks as the measurements are not compared with guidelines that take into account the potential of harm from radiation too weak to involve a *hazard from heating*: The chances that NKOM will ever find that the exposure from microwave communications exceeds the recommended limits for the general population are thus extremely low, regardless of whether NKOM measures the radiation from mobile masts or other microwave sources. NKOM's measurement of AMS/smart meters demonstrates this.

41 P. Pacher, J. S. Beckman, L. Liaudet: Nitric oxide and peroxynitrite in health and disease. *Physiol Rev.* 2007 Jan;87(1):315-424, and Martin L. Pall: Explaining, Unexplained Illnesses. Harrington Park Press, Inc. New York, 2007

42 ICNIRP 1998, see note 5.

43 Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Folkehelseinstituttet, 2012, <http://www.fhi.no/>

44 ICNIRP 1998, see note 5.

45 More about why this is so will come later.

Other authorities are responsible for product safety, environmental compatibility, installation rules, etc. and relate more or less directly to ICNIRP's guidelines.

20 NKOM's measurements and ICNIRP's and EUROPAEM's recommendations

NKOM has carried out measurements of a small number of meters in practical situations.⁴⁶ NKOM, which itself is not supposed to carry out assessments of health risks, does so anyway:

“The limits include a significant safety margin in relation to adverse health effects.”

The report naturally finds that the exposure is very low, as it only compares to the current limits based on ICNIRP guidelines:

“All meters stay well within the regulations for exposure. The exposure to electromagnetic fields is, as expected, very low and far below the current limits.”

ICNIRP's guidelines indicate that *exposure should be measured by calculating the average level of exposure over six minutes*. Doing so makes good sense when calculating the risk of *heating hazard*, but it does not make sense if the health risk is related to completely different characteristics, e.g., strong pulses with long pauses in between, as we have seen previously that AMS/smart meters transmit: Then the average level is inevitably very low and unrelated to the health risk.

NKOM also finds that the average exposure is only *ten thousandths of the limits*.

It is clear from the report that the authors find such a measurement method quite pointless, so they also state the *peak value of the signal*, and compare it with the current limits. Then they reach *0.1 to 1 hundredth of the recommended limit*.

If we compare NKOM's measurements to guidelines that take into account current research results on biological effects and clinical experience,⁴⁷ we see the large gap between ICNIRP-based limits and biologically relevant guideline values. This is done in the following table by comparing NKOM's measurements with Table 3 in the EUROPAEM 2016 guidelines.⁴⁸

EUROPAEM is the organisation for European medical doctors specialised in environmental medicine. Their recommended exposure values are in line with several other recommendations from expert groups that do not find ICNIRP-based limits medically acceptable. This is discussed in detail later (see Section 5.2).

We see from the table in Figure 12 that EUROPAEM's recommendations are exceeded in NKOM's measurements by a factor of 500 to 22,000:

46 Advanced measurement and control systems Measurement of transmission patterns and EMF exposure, National Communications Authority, January 2018, https://www.nkom.no/fysiske-nett-og-infrastruktur/elektromagnetisk-straling/_attachment/download/e2080144-5414-455b-8c8e-add667c6ac5a:ce2b3f4e8b5973662d20692f3d04cb55ebc060d3/Avanserte%20m%C3%A5le-%20og%20styringssystemer%20-%20m%C3%A5ling%20av%20eksponering%20og%20sendetid.pdf

47 See within section 5.2, and note 33 for full reference.

48 Here we simplify a little by rounding and only measuring one model from each meter manufacturer. This has no practical significance for the result. Reference values in EUROPAEM 2016 have been chosen at discretion based on pulse frequency and transmission frequency.

	Transmission frequency (MHz)	Highest measured power density, 1 m distance ($\mu\text{W}/\text{m}^2$)	EUROPAEM 2016 ¹⁾ ($\mu\text{W}/\text{m}^2$) at night	Norwegian limit ²⁾ ($\mu\text{W}/\text{m}^2$)
Kamstrup	444	22 000	10	2 220 000
Nuri	870	5 000	1	4 350 000
Aidon	870	30 000	1	4 350 000

1): The values recommended here apply to exposure of the general population to pulsed signals at night. For daytime, EUROPAEM recommends to multiply by 10, and for the extra sensitive to divide by 10.

2): Identical values to ICNIRP's guideline reference values for protection against thermal damage.

Figure 12: NKOM's measurement results compared to EUROPAEM's recommended exposure values for the general population – Frequencies and exposure limits for AMS/smart meters being installed in Norway

NKOM's report is also rather inadequate and emphasises that the measurements were carried out at very short distance in specific situations, which adds uncertainty. The measurements were also not made under conditions with a lot of "traffic" in the mesh network passing through to other meters. Also, no information is provided on the size of the mesh networks. Meters that transmit at full power have also not been measured, whereas experience suggests that they can do so quite often.⁴⁹ It is also unclear which software versions were installed, how these differ from today's versions or could conceivably differ from tomorrow's versions.

But these weaknesses in NKOM's measurement report are trifling compared to the really big weakness: The measurements are set against limits that seem to be quite irrelevant for what they are used for, which is to provide protection against health impacts from the radiation emitted by AMS/smart meters.

When we compare NKOM's measurements with medically relevant recommendations, the picture is inverted, the AMS/smart meters have pulse levels that are sky-high above the recommendations.

21 EMF – electromagnetic fields

Such fields are formed around all electricity, down to the weakest at the cellular level or in the nervous system or within atoms. Electromagnetic fields affect each other and can interfere with each other (*interference*). The extent of interference varies and is often unknown.

Electric and magnetic fields of varying strength are generated around all power lines. Around power lines carrying *alternating current* (AC), the field pulses at a certain rate – 50 Hz in Europe, and extends some distance from the lines, depending on the current in the cables. The fields around cables can be reduced, e.g., by using shielded, earthed cables. This reduces the fields almost completely. It is also possible to buy shielded soft wires, e.g., for electric lamps.⁵⁰

When the pulsing becomes strong enough, the wires begin to radiate, acting as an *antenna* that emits *radio signals*. Radiation can be perceived as *particles* emitted from the antenna, or they can be perceived as *waves*. Waves in digital electrical systems are abrupt, not smooth like sine curves or waves in water.

49 Flydal, E: [Smart meters send wild animals in apartment blocks: - Now I've also become sensitive to the mobile phone!](#), 20/03/2018

50 See Flydal, E: [Was WiFi the culprit? No, and the problem was easy to fix](#), blog post, 28/04/2017

Shielding against radio communications can be done in several ways – graphite paint, textiles, metallic wallpaper, clothing, etc. There are several online shops for such goods.⁵¹ The point of such measures is to create a kind of Faraday Cage – which blocks electric fields. It is not 100% effective, but it can be highly efficient.

22 Acute health problems and long-term health damage/illnesses

Biological reactions to man-made electromagnetic fields have been reported since modern research started in Europe in the 1750s.⁵²

There are positive effects exploited therapeutically, e.g., in electro-acupuncture.⁵³ Such treatment has a long tradition, although the mechanisms of action may be poorly understood as are the possible side effects. Therapeutical aspects are not the subject of this document.

As both assumed and well understood causal mechanisms show that the *biological impact of EMF affects basic biological functions* – for example; the oxidation processes in cells, how it opens collagen molecules in the body's membranes to allow fluids to pass through, or the frequency of signals in the nervous system – the spectrum of both acute reactions and long-term effects is very large. How they emerge may both be governed by chance, by weaknesses, or by causal chains that can be studied. Symptoms may be very specific or quite diffuse. Some MUS – Medically Unexplained Symptoms – may be caused by electromagnetic fields, possibly in combination with other environmental pollutants.⁵⁴

Acute health problems from EMF are often referred to as *electromagnetic sensitivity* or *electromagnetic hypersensitivity*. Acute health problems are those that can appear immediately or within a few hours or a few days and then disappear as soon as the exposure disappears – or within a few hours or days.

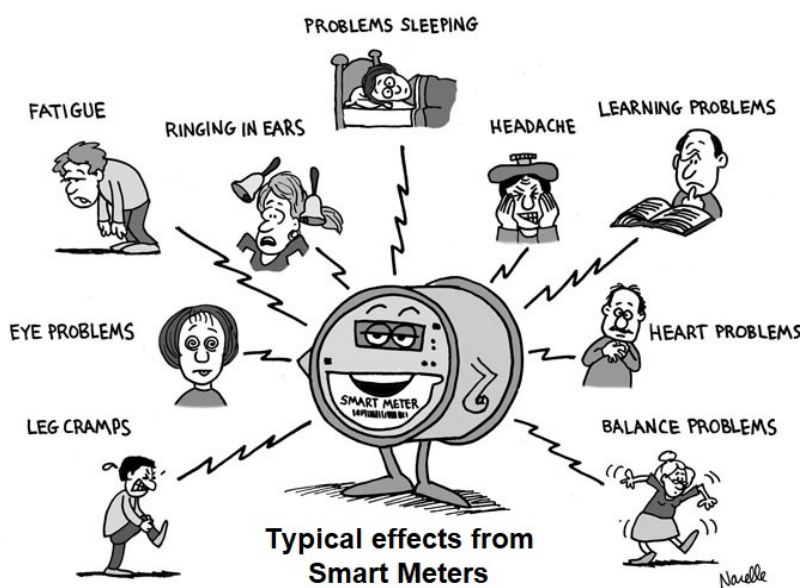


Figure 13: Effects that often recur in statements from sufferers
(Source: www.emfsafetynetwork.org and www.narellecartoons.com)

51 You can download a useful guide here: <http://emf-consult.com/emf-info/emf-beskyttelse/>

52 Firstenberg, A, *The Invisible Rainbow – A History of Electricity and Life*, 2017.

53 Martin Pall mentions having found more than 1,000 research articles that find such positive effects, see Pall, ML: lecture, [Electrosmog - The new environment health toxin](#), YouTube, 2014

54 Pall 2007, see footnote 41.

Acute complaints that seem to recur in connection with AMS/smart meters are shown in the following figure, commonly found on websites around the world. These complaints are also observed in the reports written by people affected in Norway.⁵⁵ See also the sources in the section on *electromagnetic hypersensitivity*.

Long-term health effects from EMF are disorders or diseases that only occur after a long period of exposure, e.g., several years, and are supposed to be attributable to EMF exposure in general.

For example; associations have been found between EMF exposure and ALS, Parkinson's, neuropathy, leukaemia and other forms of cancer,⁵⁶ various inflammatory and energy loss disorders,⁵⁷ etc. However, precisely because the spectrum of symptoms is so wide, the statistical correlations may be weak and the causal chains may be extremely complex and difficult to establish, while the observations seem clear in individual cases. This is a problem connected to scientific methodology.

The understanding that there are common biophysical mechanisms that can be influenced and result in both acute and long-term health damage is both old and new: It is forgotten from time to time in some professional communities, while it is preserved in others. It reappeared in a new version with the understanding of the internal chemistry of cells and the impact from environmental pollutants on oxidant production in cells. (See previously under *17 Cocktail effects and thresholds*.)

Excerpts from Smart meter stories.⁵⁸

In the summer of 2017, my health changed significantly. Dizziness, headache, an unpleasant loud buzzing sound in the head, and an electric sensation throughout the body. Went to the doctor, who found nothing. Then I accidentally found out that 16 smart meters were installed in an electrical cabinet about 2 metres from my bedroom (I live in an apartment). Then I stayed for one week with friends who didn't have a meter and after about a day my health was normal. I returned home and the problems recurred.
(no. 86. 09 May 2018)

When the AMS first came into the neighbourhood: The skin on my hands cracked and since become full of white itchy dots when I hold and use a mobile phone. Pain in the ears, stinging like onboard an aeroplane when you have blocked sinuses. Dry cough. Pain in ovaries. Then we got AMS in the house. The pain became more intense. A lot of itching in the skin, flu symptoms, pain in the throat, stuffy nose. When I type, my fingertips itch.
(no. 89. 22 May 2018)

At the end of March 2018, my daughter and I moved into a house where an Aidon smart meter had been installed. Almost immediately I noticed strong pressure in my head, severe ringing in my ears, headache, depression, internal tremors and fatigue. My daughter also became abnormally tired. We go to bed tired and weak and wake up tired and weak. I am nauseous and unwell, completely without energy and have constant stress in my head and body.
(no. 88. 20 May 2018)

55 See for example: Smart meter stories: <https://einarflydal.com/smartmaler-historier/>

56 Flydal, E: [Something you hardly knew about car tyres](#), blog post, 10/01/2017

57 Isager, Henrik: *Blind spots – about the amputated reality of medical science and the health sector*, Forlaget Hovedland, 2011

58 <https://einarflydal.com/smartmaler-historier/>

It has only been 7 days since I had my smart meter installed. It's in the bedroom. I didn't understand why I got a headache, why I sleep badly and feel exhausted. I have never had these problems before. The dog stopped sleeping in there, it now uses the living room.

(no. 40. 16 October 2017)

The symptoms came gradually: I often had very severe headaches with vomiting. My right arm eventually went numb in the evening. Tired in the morning and with palpitations. My fingers were swollen and sore with oozing sores and scabs. My right shoulder became more and more painful to move. Eventually I was unable to gather my hair in a bun behind my neck. A bluish-purple large sore lump appeared in my right armpit. The swelling in my fingers disappeared when I was out of the house for a few hours. This happened several times. The doctor issued a statement that I could not tolerate the meter.

(no. 36. 31 August 2017)

23 Electromagnetic sensitivity, Electromagnetic hypersensitivity

'Electromagnetic sensitivity' and 'electromagnetic hypersensitivity' refer mainly to *acute reactions resulting from exposure to electromagnetic fields*.

Current health policy in the Nordic countries and several others, is that such reactions cannot be caused by exposure to electromagnetic fields as long as the energy density is weaker than the current limits, and certainly not when they are as weak as from AMS/smart meters:

“There is no documented connection between health problems and such weak radiation.”⁵⁹

This view is mainly based on the "knowledge base",⁶⁰ which is discussed later. It is in clear conflict with a very extensive body of research and observational evidence.

Several of the first "electricians" – those who experimented and exposed themselves to constant, but very weak electric shocks in the early 19th century – themselves developed severe ailments from their exposure. In their research and treatment, they also observed large variations in sensitivity among the patients, both in terms of how strongly they reacted and how they reacted to shocks and "electric baths".⁶¹

The term 'electromagnetic hypersensitivity' itself is unclear and difficult to define. As currently used in Norway in connection with AMS/smart meters, a person is considered *electromagnetic sensitive if they react to electromagnetic fields weaker than the current recommended limits*. Such a definition can easily lead to a situation where what is considered a *normal* health reaction to EMF in countries with stricter limits, must be considered electromagnetic hypersensitive in e.g. Norway, since the reaction occurs below the limits and is therefore considered not to be possible.

It is also common to use the term *electromagnetic hypersensitivity* to refer to being *significantly more sensitive than most people* to electromagnetic fields. *This is how it will be used here.*

Many different terms have been used for such extra sensitivity or transient, acute symptoms upon exposure. In defence it became known in the 1950s as *radioman's disease* and *radar-man's disease*.

59 Medical certificate and automatic current meters, message to GPs from the Norwegian Directorate of Health, 14 March 2018, <https://helsedirektoratet.no/nyheter/legeattest-og-automatiske-straummalarar>

60 For Norway, among others; Alexander 2012, op. cit. usually referred to as FHI report 2012:3. See note 8.

61 See Firstenberg, A, *The Invisible Rainbow – A History of Electricity and Life*, 2017, for primary references.

From around the 1850s, *neurasthenia* was used as a term, before the West switched to linking this term to purely psychological conditions.⁶²

A wide range of other expressions are also used. A Danish website mentions the following in a brief review of history:⁶³

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 hypersensitivity (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, Idiopathic Environmental Intolerance with attribution to EMF (IEI-EMF), Electromagnetic field intolerance syndrome (EMFIS), Microwave sickness, Microwave syndrome, Microwave hearing, Electrohypersensitivity, Wi-Fi syndrome, Electromagnetic hypersensitivity, Neurasthenia

The mechanisms that trigger or maintain electro-hypersensitivity are not definitely clear. They can certainly be several. There are many observations which suggest that electromagnetic hypersensitivity can develop both during *sustained exposure to weak fields*, and after *brief exposure to strong fields*.⁶⁴

What proportion of the population are those who are electromagnetic hypersensitive? It is not easy to answer, as the answer depends heavily on definitions and calculation methods:

In surveys carried out between 1985 and 2004, the proportion of electromagnetic hypersensitive people in the population of some Northern European countries and in California was found to range from 0.06% to 13% of the population.⁶⁵ However, these surveys are quite weak scientifically, partly because many of them are based on the respondents' self-perceptions and self-diagnoses.

We go to the opposite extreme if we assume that everyone who has medical conditions affected by the electrical discharges in *weather systems* should be considered *electro-sensitive*, whether they themselves notice being affected or not. Then we have to assume that *30% to over 50% of the population are electro-sensitive* – the vast majority without being aware of it.⁶⁶

There is a very extensive literature on electromagnetic hypersensitivity in the sense of reacting acutely and much more readily than others. It ranges from clinical (medical) observations to

62 See Firstenberg, A, *The Invisible Rainbow – A History of Electricity and Life*, 2017.

63 <https://www.e-stress.dk/historie>, visited 30.5.2018 [Website no longer exists.]

64 For example: Carpenter, David O.: Excessive Exposure to Radiofrequency Electromagnetic Fields May Cause the Development of Electrohypersensitivity, *Alternative Therapies*, Nov/Dec 2014 VOL. 20, 6, https://www.researchgate.net/publication/269184131_Excessive_Exposure_to_Radiofrequency_Electromagnetic_Fields_May_Cause_the_Development_of_Electrohypersensitivity

65 Hallberg, Örjan & Oberfeld, Gerd: "Letter to the Editor: Will We All Become Electrosensitive?", *Electromagnetic Biology and Medicine*, 25: 189–191, 2006

66 Firstenberg 2017 op cit. up to 30%. Baumer, Hans and Sönning, Walter: On the biological effectiveness of natural and technical low-frequency E-fields: Sensitivity to the weather and "mobile phone sensitivity". (Summary) May 2005, note, states "more than half of those interviewed" in demographic surveys. The note is reproduced in section 4.2.6.

theoretical tests, laboratory tests, academic studies, epidemiological studies, individual descriptions, self-reports and lecture notes.⁶⁷

Symptoms appear over a very wide spectrum. However, certain symptoms are common. Here is the list of symptoms from "microwave sickness", as established by the Soviet Union in the 1970s after extensive observations since 1948, including long-term observations of over 1,000 people for more than 10 years:⁶⁸

- neuro-vegetative disorders
- neuroses
- depressions
- daytime fatigue
- lethargy / exhaustion
- insomnia
- headaches
- various kinds of cardiovascular regulatory changes
- hyperactivity and agitation

In the Soviet research, it was found that the longer the duration of the exposure, the more severe the symptoms and the higher the sensitivity to exposure. A *cumulative effect* was therefore found.⁶⁹

A large number of collected self-reported statements about practical experiences with AMS/smart meters in Norway support that AMS/smart meters can both trigger health problems in people who are already electrically hypersensitive and that they can trigger electro-hypersensitivity among people who were not previously aware of the problem before.⁷⁰ Some of the stories told have the characteristics of double-blind tests.

67 From the extensive documentation, mention is made of:

- EUROPAEM 2016, se note 33
- Bevington, Michael: Electromagnetic Sensitivity And Electromagnetic Hypersensitivity (Also Known As Asthenic Syndrome, EMF Intolerance Syndrome, Idiopathic Environmental Intolerance – EMF, Microwave Syndrome, Radio Wave Sickness) – A Summary, Capability Books, 2013, <http://www.es-uk.info/>
- Erica Mallery-Blythe (Dr.): Electromagnetic Hypersensitivity A Summary, December 2014, Working Draft, Version 1, <http://www.iemfa.org/wp-content/pdf/Mallery-Blythe-v1-EESC.pdf>
- Steven Weller: Electromagnetic Hypersensitivity, mai 2015, <https://stopsmartmetersau.files.wordpress.com/2015/06/steves-emerg-ehs-presentation.pdf>
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- Pall 2007, op. cit.

68 Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

69 Hecht, op. cit., see note 68.

70 See Smart Meter stories, <https://einarflydal.com/smartmaler-historier/>

Similar stories emerged when the first generation of office computers and monitors were introduced into working life in the Nordic countries, the USA and Canada. From the reports collected, there is a systematic analysis with quotes from around 400 stories from Sweden.⁷¹ Around 4,000 people were registered as injured in Sweden alone.

If the Norwegian (and identical Swedish and American) limits actually protected against health problems from EMF, such health problems should not occur: No one suffered heating injuries and there was no suspicion that the current limits were exceeded.

Drawing a red herring across the trail

The story of those who became electrically hypersensitive to the first office computer monitors is also a story of how a kind of general perception arose that *the explanations for these health problems had not been found, and in any case did not seem to be found in electromagnetic fields.*⁷²

Many of the cases of permanent "screen injuries" were investigated without doctors or scientists being able to identify the cause of the health problems. However, some research projects found undoubted biological changes that could be linked to exposure to the cathode ray tube based computer screens of the day and their magnetic fields. Among other things, skin changes ("screen dermatitis")⁷³ were found which proved to be linked to the growth of cutaneous mast cells when exposed to such screens.⁷⁴

Others started to look for answers in completely different directions: For example, very many of those with "screen injuries" became ill from fluorescent lights. Some researchers began to investigate whether it was the flickering of the neon light – not the sharp electric fields from the neon light – that could be the cause of the health problems.⁷⁵ It was almost as if someone had drawn a red herring across the trail leading to electromagnetic fields being the cause of electromagnetic hypersensitivity. Eventually, a kind of consensus emerged among authorities and leading scientists in the technical community that electromagnetic fields were not the cause, but that it rather had to be explained *psychologically*.

However, the Swedish trade union TCO and some small research groups stood their ground.⁷⁶ This led to the development of the now international TCO standards in 1995 and 1999⁷⁷ for computer monitors. They regulate, among other things, electric and magnetic fields, static electricity, image refresh rate, etc.

71 Granlund-Lind, Rigmor & Lind, John: Black on white, Voices and testimonies about electro-hypersensitivity. Sala 2002. 224 pp. English edition: Granlund-Lind, Rigmor & Lind, John: Black on White. Voices and Witnesses about Electrohypersensitivity. The Swedish experience. 2005. Mimers Brunn Kunskapsförlaget.

72 For a slightly fuller presentation see Flydal, E: Fluorescent tubes and suicide: A case for Harry Hole? blog post, 10/04/2017

73 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

74 Johansson O, Gangi S, Liang Y, Yoshimura K, Jing C, Liu P-Y. Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary TVs/PCs – results from open-field provocation experiments. J Cutan Pathol 2001; 28: 513–519

75 Wibom, R., Nylén, P., Wennberg, A.: Flicker from fluorescent tubes. A possible contributing cause of discomfort in "electro-hypersensitivity". Arbetslivsinstitutet survey report 1995:31

76 Nordström, Gunni & von Schéele, Carl: Sick of the screen, Tiden Förlag, Stockholm, 1989

77 TCO Monitor Standards, PC Tech Guide, <https://www.pctechguide.com/crt-monitors/tco-monitor-standards>



Figure 14: Information leaflet on electromagnetic hypersensitivity from a Swedish union of employees in governmental service, circa 1995

2.2 The WHO's classification system ICD-10 conceals EMF as a health problem in its Norwegian version

ICD-10 is the WHO's international classification system for diseases and health conditions.⁷⁸ It is used internationally to, among other things, create uniform disease concepts and health statistics. [Since this book first appeared in Norwegian, a new version, ICD-11 has been published. The general points are, however, still valid, although the text below has not been updated.]

In Norway – as probably in many other countries – ICD-10 is used by the specialist health service to set classifications for administration, financial reimbursement and health statistics. The specialists in the Norwegian public healthcare system are not allowed to use diagnoses that do not exist in ICD-10. This makes ICD-10 a useful common understanding device, but at the same time a powerful and inflexible management tool.

A less detailed classification system, ICPC-2, is the equivalent international classification system to be used by primary health care, i.e. by the doctors who are general practitioners.

Both classification systems include both acute disorders and diseases that emerge over a long period of time. Disorders/diseases that develop over the long-term are disregarded below, as we take for granted that they have their codes in the ICD-10 system, even if these do not say anything about their cause.

Acute reactions to EMF exposure – including electro-hypersensitivity (EHS) – are recognised in several categories in ICD-10, but not in the Norwegian version: Such reactions are not covered.

⁷⁸ ICD-10 Version:2016, <http://apps.who.int/classifications/icd10/browse/2016/en>

In ICD-10, the codes R68.8, T66, W90, Z58.4 and R68.8 in addition to the diagnosis of neurasthenia (F45.3, F48.0) could cover symptoms from non-ionizing radiation. The latter term, neurasthenia (or asthenia), is widely used for EMF ailments across large parts of the globe, while in the West, since Freud, this term was used for mental illness only and is now no longer in use.⁷⁹

*However, none of these diagnoses are available or allowed to be used for such a purpose in Norway.*⁸⁰

- *R68.8 Other specified general symptoms and signs* are used for environment-related "idiopathic" disorders, that is, disorders of unknown cause and unknown triggering cause. A proposal was put forward that reactions to EMF exposure could be classified as such in the Nordic countries, but it was not accepted.⁸¹
- In Norwegian, T66 is given the title *T66 Unspecified Conditions caused by Radioactive Radiation* [our emphasis]. Radioactive radiation is ionizing radiation. The wording thus rules out that this code can be used in cases of *non-ionizing* radiation. However, the word "radioactive" is not present in ICD-10's international version. T66 therefore does not originally indicate whether the radiation must be radioactive or not. This addition has, however, been made to the Norwegian version. Hence, the Norwegian code does not correspond to the English one.
- The codes *W90 Exposure to Other Non-ionizing Radiation* and *W91 Exposure to Unspecified Radiation* are simply not included in the Norwegian translation. Thus, the option to use these two codes has also been removed. By so doing, a serious limitation has been introduced to the imagination: That healthcare systems in other countries might have quite different ideas as to how and where exposure limits should be set to protect the public.
- *F45.3 and F48.0 Neurasthenia/asthenia* are not included in the Norwegian version.
- *Z58.4 Exposure to Radiation* belongs to a group of codes for reasons why you have had contact with the public health service. The class is used to indicate reasons related to *environmental conditions*. Until quite recently (spring 2018) it specified "due to potential health risks in connection with socio-economic and psychosocial conditions", which one could not easily understand also could include environmental toxins.

With a fairly recent exception for Z58.4, electromagnetic (hyper)sensitivity could therefore not be indicated by the use of codes stating anything about electromagnetic fields as the cause behind the symptoms. In this way, electromagnetic (hyper)sensitivity has been, and still is, an invisible category in the health statistics: It is not possible to find data in Norwegian health statistics on the incidence of EMF-related acute health problems. Neither are those with electrical sensitivities found on the health authorities' publicly accessible mailing lists if they write complaints to the authorities, since their correspondence is exempt from public disclosure for privacy reasons, as the letters contain personal health information. Hence, they become invisible both as individuals and as a group.

We may assume that the explanation for this deficiency in the Norwegian version of ICD-10 is that, according to what the health authorities refer to as the knowledge base for radiation protection⁸², there is no basis for claiming that someone can possibly become electro-sensitive or suffer health

79 Firstenberg 2017, see note 52; see the use in practice in Hecht, Karl: Health implications of long-term exposure to electrosmog, Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V. 2016, http://kompetenzinitiative.net/KIT/wp-content/uploads/2016/07/KI_Brochure-6_K_Hecht_web.pdf

80 For the Norwegian version of ICD-10, see <https://finnkode.ehelse.no/#icd10/0/0/0/-1>

81 Levy, Finn & Wannag, Axel (red.): The Nordic Adaptation of Classification of Occupationally Related Disorders (Diseases and Symptoms) to ICD-10, Nordic Council of Ministers, 2000, http://media.wix.com/ugd/86579e_95ad26d185144c0a94b057a86dc3a1c8.pdf

82 FHI-rapport 2012:3 op. cit., see note 8

problems from EMF exposures weaker than the thermally based exposure limits recommended by the Radiation Protection Agency, DSA. However, the ICD-10 classifications in English are less restrictive.

That electromagnetic (hyper)sensitivity cannot possibly exist, follows logically as soon as one accepts "*the thermal paradigm*": If no health effects could possibly result from non-thermal exposure levels, then, according to this logic, electromagnetic (hyper)sensitivity cannot result either. Hence, ICD-10 reasoning also tends to give more credence to those research reports that do not find any connections, and should, according to normal evaluation procedures, be disregarded. And the other way around. The thermal paradigm justifies the restrictions in the Norwegian ICD-10 version.

2.3 Acute reactions to EMF – from reality to imagined suffering

The health authorities in Norway claim that acute reactions to electromagnetic fields – electrohypersensitivity or EHS, in a broad sense of the word – cannot have anything other than a *psychological* link to electromagnetic fields – i.e. anxiety or imagination. Or – to be more "scientific" – *that no biophysical link to exposure to electromagnetic fields can be demonstrated.*

It is this position that was expressed when the Directorate of Health instructed GPs in March 2018 not to help with applications for exemption from AMS/smart meters by writing out certificates where radiation from AMS/smart meters was identified as the cause of health problems. Parts of the wording was: ⁸³

“Patients who come to the doctor with health problems that they believe are due to radiation or electromagnetic fields should be taken seriously. Their ailments may be real, even if they are not caused by electromagnetic fields.

[...]

The Directorate of Health uses the Institute of Public Health's [FHI's] summary of knowledge from 2012. Here, the FHI went through many scientific studies. The FHI did not find any evidence that radiation below the recommended limit causes health risks.”

The Norwegian Directorate of Health expresses itself in such a way that the reader must understand that acute reactions cannot result from EMF exposure. Strictly speaking, the Directorate does not claim so, but has by this reference washed its hands if the knowledge base is incorrect. In this way, the Directorate shifts responsibility away from itself, but at the same time shows responsibility and care by expressing what has been repeated many times over in various WHO statements in recent years, that *even if the symptoms have other causes* (implicitly: imagination, i.e. a nocebo effect), *then "the symptoms are real enough for the person suffering from them, and that it is of course the responsibility of the healthcare system to deal with this and treat the patient with respect"*.

As references, the Institute of Public Health cites the so-called "*FHI report*",⁸⁴ from which parts of the wording are taken, and to *Stråleverninfo 09 17*, an information sheet from the Norwegian Radiation Protection Authority.⁸⁵

The main messages in the information sheet from The Norwegian Radiation Protection Authority are the three points that the radiation from the AMS/smart meters is; 1) of *so short duration*, 2) *so rare* and 3) *so much weaker than the radiation from mobile phones* that it cannot pose any health hazard. This has been shown to be thoroughly wrong on all three points, and the errors have been partially acknowledged. A more detailed review is found in Chapter 3.

83 Helsedirektoratet 2018, op. cit., see note 59

84 FHI-rapport 2012:3, op. cit., see note 8

85 Norwegian Radiation Protection Authority 2017, op. cit., see note 30

The report referred to by the Directorate of Health as "The Institute of Public Health's scientific summary from 2012", is not the Norwegian Institute of Public Health's (FHI) knowledge summary at all, but a report from *an independent committee* that was entrusted to the Norwegian Radiation Protection Authority to appoint, and to a secretariat from the FHI to lead.

The fact that the committee's report was published in FHI's series of publications (as FHI 2012:3) has given the report and the summary of knowledge it contains an unjustified tinge of formal endorsement in the Norwegian administration. FHI's director, Camilla Stoltenberg, has made clear several times what is stated in the report's introduction – that the FHI is not responsible for the report's content and that the responsibility lays solely with the committee members:⁸⁶

“The role of the Norwegian Directorate of Health has been to lead and participate in an expert group with participants from several scientific communities at home and abroad, to assess the possible health effects of high-frequency electromagnetic fields. The health authorities, represented by the Ministry of Health and Care, have chosen to use the conclusions of the expert group as the scientific basis for the advice provided by the Norwegian Radiation Protection Authority.”

By such citations, the Directorate of Health lends weight to its warning to GPs. The Directorate refers to information from the Norwegian Radiation Protection Authority that was proven to be highly misleading six months earlier, and by ‘dressing up the committee's report with fake feathers’.

But how does the committee's report come to the view that acute reactions – electromagnetic hypersensitivity – cannot possibly stem from EMF exposure?

The committee has, similarly to such committees internationally, been heavily criticised for its selective use of sources and its work methods, as well as for bias, unfairness and weak scientific rigour.

Through such a process, the committee concludes that there is no research that demonstrates health effects from radiation below present recommendations with sufficient certainty for it to be taken into account when forming exposure limits.

Hence, the research that the committee regards as sufficiently solid, does not demonstrate any correlations, and is established as the Norwegian Radiation Protection Authority's "knowledge base".

Such a general conclusion necessarily also implies the view that research findings that demonstrate acute health reactions must be false findings – i.e. that those research findings are not real, but due to weaknesses in the research project. According to such logic, acute reactions to EMF exposure – electro-hypersensitivity or EHS – must therefore have other causes.

Furthermore, the committee justifies this conclusion by referring to a very modest study commissioned by the Directorate of Health five years earlier (in 2006).⁸⁷ The commissioned study was carried out by a researcher who belongs to the network of ICNIRP-affiliated researchers, a network that excels in never finding any health injuries from microwave radiation – while a number of other researchers and a large majority of the research articles published do find such associations (see Figure 3).

The commissioned study reviews quite superficially some very rough, even scandalous laboratory experiments that have been carried out to test for electro-hypersensitivity, studies which in principle

86 I.a.; in email from Camilla Stoltenberg, FHI, to Einar Flydal on 30 September 2014

87 Oftedal, Gunnhild: "Electro-hypersensitivity - investigation into causes and possible measures and treatment plans", investigation commissioned by the Norwegian Social and Health Directorate, Sør-Trøndelag University College, Dept. for technology, 2006, <http://docplayer.me/5088828-Rapport-el-overfølsomhet-utredning-om-arsaker-og-molige-tiltak-og-behandlingsopplegg-isbn.html>

appear as methodologically rigorous and systematic. The review bears the impression of a foregone conclusion: It quite unjustifiably slides towards the conclusion that none of the reviewed studies that Oftedal finds useful, demonstrate any systematic connection between exposure and acute reactions, and that it must therefore be assumed not to exist.

However, this commissioned study leaves out significant studies that find particularly clear and distinct connections,⁸⁸ and relies on studies that have clearly not been conducted with the insight required to be able to capture the systematic nature behind the reactions. For example, they assume that reactions appear instantly, while many only suffer reactions hours or days afterwards. Or that everyone reacts to the same type of exposure and that the stronger the exposure, the stronger the reaction.⁸⁹

The scientific basis for claiming that you cannot get acute reactions from microwave radiation is thus extremely thin and rests on a completely untenable foundation.

How was it possible that a committee appointed by the Ministry of Health and Social Affairs and the Norwegian Radiation Protection Authority, could virtually wipe away more than 200 years of scientific knowledge about acute health effects from electromagnetic fields, make those who suffer such effects distrusted in the health care system and make it legitimate to spread an environmental toxin with well-documented harmful effects on health?

This is discussed in a larger context in Chapter 8 onwards. There it is referred to as resulting from a number of factors, including professional traditions and conflicts of interest, which lead to practices and guidelines being allowed to dominate contrary to good scientific practice, fairness and general health policies.

88 Rea, William & al, Electromagnetic Field Sensitivity, Journal of Bioelectricity, 10 (1&2), 241-256, 1991

89 For a basic critique of the validity of all such provocation tests that Oftedal reviews and draws conclusions from, see Leszczynski, Dariusz: BRIEF REPORT on the EHS provocation studies, February 11, 2018, note, <https://betweenrockandhardplace.files.wordpress.com/2018/02/leszczynski-updated-brief-report-on-ehs2.pdf>

3. AMS/smart meters for electricity, communication methods and health risks

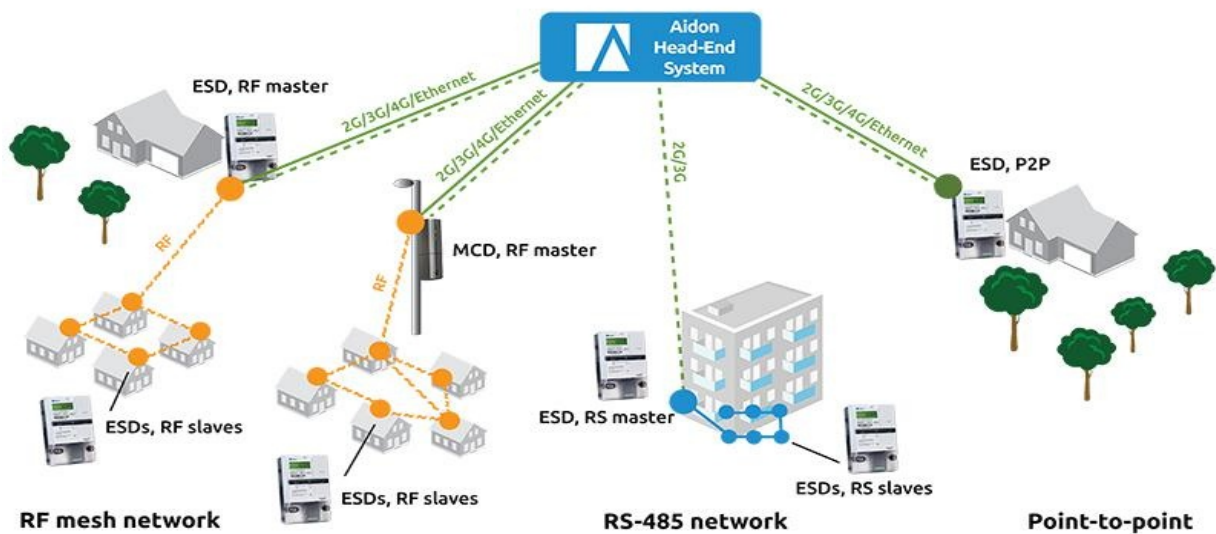


Figure 15: Principle communication solutions for smart meters
(Source: Aidon's website)

In Norway, three different brands of radio communication-based AMS/smart meters are installed – *Aidon*, *Kamstrup* and *Nuri*. Figure 15 (from the producer of Aidon meters, Finland) shows "smart meters" in various typical technical configurations.⁹⁰ For the purpose of this book, we assume that they are all similar as to their technical configurations.

From Figure 15, we see the following:

- Several alternative communication methods may be used to reach the last link (green lines) to the grid company's computer systems (in blue at the top): 2G (GSM), 3G, 4G or wired Ethernet can be used.
- Locally, a wireless mesh network (RF mesh network) may be used, with a concentrator ("RF Master") (orange lines and dots, bottom left) communicating with the grid operator's connection point.
- Individual meters may communicate with the grid operator separately via mobile networks, or via a simple data cable (Ethernet connection, far right).
- Several meters may be connected locally in a cabled network (blue lines and points in the apartment building). This is done in accordance with an established technical standard (RS-485).
- Local meters in wireless mesh networks communicate in groups (up to 100 to 200 meters per group) with the grid company via one of the meters (Master), or via some other kind of local connection point (MCD RF Master).
- Local "masters" collect data from the local network, and convey management instructions, software updates, operational monitoring of the grid/network, etc.

In the Norwegian AMS meter roll-out, the choice of meter and technical solution is the grid companies' responsibility. Installation time is a critical factor for the profitability of the project,

⁹⁰ <https://www.aidon.com/>, autumn 2017

hence it is no wonder that NVE, i.e. the national Water and Electricity Agency, and the grid companies have agreed *microwave-based self-configuring radio communication networks* to be the technical communication solution for the majority of cases. It appears from NVE's progress reports that NVE has been involved and informed about the technology choices and has closely followed the finances.⁹¹

In most cases, a meter model has been deliberately chosen which, according to the grid company, HafslundNett [after a merger named Elvia], excludes local cabling.⁹² This means that even in situations marked in the figure with a blue line and blue dots – where the meters are placed closely together and as such could easily be wired in local networks between meters, can allegedly not be delivered in Norway. *Even between meters side by side, a microwave-based mesh network is the only communication solution delivered.*

*This means there are meter rooms where many meters transmit between each other continuously at a distance of 5cm and that people near such installations, or who enter such meter rooms, may experience an acute headache after only a few seconds. Several such cases have been reported.*⁹³

*The three meter brands have functions that are specified by NVE in terms of data collection etc., and some of the technical characteristics for transmission are regulated by the Free Use Regulations.*⁹⁴ All three transmit in the microwave frequency region and use digital signals that are sent in short, strong pulses.

Such pulses form their own low-frequency "energy shocks" which, since before the Second World War, have been documented as highly biologically active in a number of research projects. The biological effects of low-frequency pulses – acute and long-term – are not regulated in the current radiation protection guidelines.

Accordingly, smart meters are normally installed in Norway as wireless mesh networks. In the case of large distances between the meters or difficult radio conditions, the ordinary mobile network (e.g. UMTS) is often used for communication directly with the electricity grid company.

The meshes are self-configuring. That is to say, upon installation, they build up the wireless mesh network as a set of temporary communication paths. When so doing, the meters transmit at full power. *This has relevance for the biological impact pattern: Cases have been reported where threshold values of sensitivity appear to be exceeded, with permanent electro-hypersensitivity (EHS) as a result.*⁹⁵

After the configuration is complete, the power is usually considerably tuned down, but will then power up to full intensity again whenever the network is disturbed and must be "rebuilt" again. Such situations seem to happen for example when a car parks in between two meters. Several situations have been observed where the network increases the transmission power at fixed times. One possible explanation is that the radio network is constantly disturbed by something that happens regularly. Even disturbance from the newspaper delivery boy passing the meters in the stairwell of a block of flats every morning has been reported as a source of re-configuring of the meters' mesh network.⁹⁶

91 See e.g. Smart meters (AMS), [Status and plans for installation as of the first half of 2016](#), NVE, report 79 2016

92 Flydal, Einar: [HafslundNett: – Smart meters cannot be wired! Is it a hoax?](#), blog post, 13/11/2017

93 Personal messages by telephone, and described in the blog post mentioned in the previous footnote. More cases can also be found in Smart meter stories, <https://einarflydal.com/smartmaler-historier/>

94 Regulations on general permits for the use of frequencies (free use regulations), FOR-2012-01-19-77

95 Smart meter stories, <https://einarflydal.com/smartmaler-historier/>

96 Launched as a possible explanation by EHS struck individual in Flydal, E: Smart meters transmit wildly in apartment block: - Now I've also become sensitive to the mobile phone!, blog post, 20.03 2018, <https://einarflydal.com/2018/03/20/smartmalere-sender-vilt-i-boligblokk-na-er-jeg-ogsa-blitt-omfintlig-for-mobiltelefonen/>

- *Situations where the mesh network is regularly activated and increases the transmission power at the same time of day have been observed by several persons as a likely source of their health problems.*

Technical communication: How often different meter brands transmit to maintain their local mesh networks varies considerably. For Aidon, beacon signals are measured to happen more frequent than once every second: The interval from one pulse to the next varied between 0.6 and 0.9 seconds. Kamstrup meters send such operational signals far less often. For Nuri, we do not have measurement data.

- *In a biological sense, such frequent pulsing is considered continuous exposure. In addition, there are harmonic frequencies.*

Reporting of consumption data also takes place at different intervals from different meters. Aidon reports at somewhat irregular intervals every hour, Kamstrup every six hours around the clock (from midnight). For Nuri, we have no data.

Content transmission will create random pulses that produce random low frequency pulses. Such "pulse trains" can therefore have random frequencies. Therefore, one must expect that they can also come with biologically active frequencies.

Also when signalling over 2G, 3G or 4G, short transmissions will occur quite frequently. The meters report consumption data to the grid company. Some do so once per hour (Aidon meters), while others do so more rarely. In addition, they transmit an occasional technical signal to maintain contact with the mobile base station, similar to a mobile phone, e.g. every 8 minutes. Each communication session will take a few seconds at most and have the same characteristics as other data communications over mobile data networks ("wireless broadband" from telecommunications companies). Simply put, one can say that such a signal equates to an SMS message.

In local mesh networks, the overall radio transmission volume will be much larger, as the mesh network must be maintained in addition to taking care of the transmission of consumption data from the meters. Consumption data is routed through the mesh network – often from one meter to the next and onwards. The meter that takes care of the communication to and from the local mesh network on to the concentrator gets extra busy, and therefore transmits more data.

In some types of mesh networks, the signalling in the mesh network will be extra high. Aidon meters have very frequent traffic, Kamstrup meters far less. This is strikingly clear from measurements shown in Figure 40.

The consumption data is just a very small part of the transmissions by the meters. The technical transmissions seem to be far more frequent and larger in volume.

Total activity over radio frequencies will depend on how the software is written and what kind of routines have been incorporated. When communication is used to maintain a local mesh network where close monitoring of electricity grid operations is desired, there will be a significant amount of transmissions in the mesh network just to maintain this. Such close monitoring is the ambition of several of the network operators.⁹⁷

3.1 PLC – Power Line Communication and dirty electricity

While France has based its roll-out of AMS/smart meters (called "Linky") on signalling via the power grid, with supplements of wireless radio networks, the situation in Norway is the opposite:

97 Roberta Bigliani: Hafslund Nett Reinvents Smart Metering with a Wide Area Mesh Network, Customer Insight, IDC, September 2017 – article paid for by Wirepas (software provider) and Aidon (meter manufacturer). <https://einarflydal.com/wp-content/uploads/2018/12/IDC-Customer-Spotlight-Hafslund-funnet-på-Wirepas-Web-side.pdf>

NVE expects that around 15% of the meters will use PLC (*Power Line Communication*), i.e. signalling over the power grid without local radio connections.⁹⁸

Signalling in the power grid means that the signal is transmitted as "noise" on the power grid, so-called "dirty electricity". All digital meters – in contrast to old analogue meters – draw power for their operation via the use of digital power supplies (called Switched Mode Power Supplies/SMPS), approximately in the same way as a mobile phone charger. Such chargers also produce "dirty electricity".

In cases where people are particularly sensitive, dirty electricity from AMS/smart meters can be a significant problem. However, dirty electricity can be filtered out.

A section on PLC and dirty electricity is found in section 12.2. There is a significant amount of research that demonstrates connections between dirty electricity and health.⁹⁹

3.2 How strong is the radiation from an AMS/smart meter?

The radiation measured as *power received* tells how strong the radiation is where it is measured, i.e. how strong the exposure is. The strength measured where the transmitter is located is called the *radiated power*.

The *power density* (the "strength" of the signal) is attenuated, i.e. drops, to one quarter when the distance to the source is doubled.

What we are normally concerned about measuring, is the amount of energy contained in the radiation, but it is far from the only thing that affects health risks. This will be discussed in more detail later. *Energy supplied over a period of time long enough to result in heating* forms the basis for today's exposure limits. There will be more about this later.

When comparing exposure to exposure limits, the measure to be used should be the total radiation from all sources present. However, this is rarely done unless by professionals in the field. In laboratories, single source are normally tested.

In order to get a correct picture, all sources must be included in the calculation, including reflections from surfaces that bounce radio waves back, such as for example, the invisible metal sheet in your front door, the metal layer in the energy saving glass in the windows, etc. If you don't do that, and usually you don't, calculations can easily become quite approximate.

Measurements are therefore needed on site to get realistic pictures of the situation. Moreover, common small meters only measure the strongest source and therefore normally report values that are too low, but still give a fair indication.

All calculations must therefore be regarded as quite approximate – both ways. Also, measurements always be approximate, but they are useful nonetheless.

Professional electronics engineer Jostein Ravndal, has provided us with several simple calculations to demonstrate exposure levels from a smart meter in a home. He took two dimensions into consideration:

98 [This was in 2018. Probably the percentage is much lower in Norway, next to nil.]

99 For more on dirty electricity and health, see Flydal, E: [Something you hardly knew about car tyres](#), blog post, 10.01.2017 and references there. For a more detailed technical description of problems and measures with dirty electricity, see references there, and Forshufvud, Ragnar: *Housing and health, a practical handbook for a healthier home*, Mimers brunn, 1998 (Swedish).

First, he looked at exposures horizontally in a house where the meter is in the hallway near a bedroom.¹⁰⁰ Here he also included the radiation from an adjacent home, as it would be in a terraced house situation.

Secondly, he looked at radiation between floors.¹⁰¹ He only made calculations for wooden houses. In concrete houses, the signals will be attenuated quite a bit more, so the values will therefore be lower.

The calculations are based on the meter transmitting at full power. This is how calculations should be done – since the meters can in practice often go up to full power when connections are disturbed and they rebuild the mesh network anew.¹⁰²

Ravndal made the purely technical calculations needed to arrive at the exposure values. Here, the results from these calculations are compared with recommended maximum exposure values from two sources: The Norwegian Radiation Protection Authority, which uses ICNIRP's reference values to protect against acute thermal damage, and secondly, guidelines from the European environmental medicine association EUROPAEM, which recommend precautionary-based reference values. The EUROPAEM Guidelines are based on the authors' perception of what is the state of knowledge in the field – research and clinical experience included.

The calculations are based on an actual situation in an existing home and are shown in Figure 16. With a distance of 1.2 m and 1.9 meters to the head pillows, exposures from the AMS/smart meter in the corridor outside the bedroom will be 29,000 $\mu\text{W}/\text{m}^2$ and 30,000 $\mu\text{W}/\text{m}^2$, respectively.

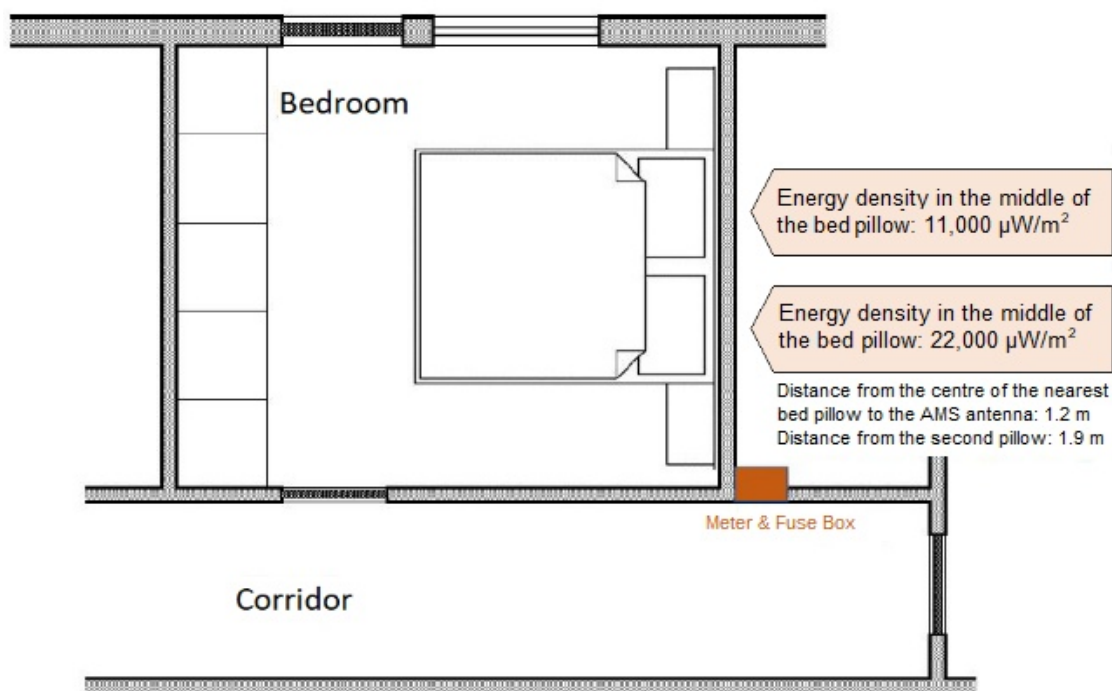


Figure 16: Calculated exposure in bedrooms for the head on the middle of the bed pillows (J. Ravndal)

100 Ravndal, Jostein: "Calculation of maximum radiation in a bedroom and in a corridor from an AMS meter", note, 20.06.2018, <https://einarflydal.files.wordpress.com/2018/06/jravndal-eksponering-fra-ams-i-trehus-sov-entre-21062018.pdf>

101 Ravndal, Jostein: "Calculation of radiation from AMS meter in mesh network", note, 20.06.2018, <https://einarflydal.files.wordpress.com/2018/06/jravndal-eksponering-fra-ams-i-trehus-mellom-etasje-20062018.pdf>

102 Flydal, Einar: [Smart meters transmit wildly in apartment blocks: - Now I've also become sensitive to the mobile phone!](#), blog post 20.03.2018

The calculated exposures are far below the ICNIRP-based Norwegian recommended limits, but far above the recommendations in the EUROPAEM guidelines¹⁰³: EUROPAEM 2016 provides several alternatives. In the table below, EUROPAEM recommendations have been chosen based on pulse frequency. Recommendations for maximum exposure at night are reproduced, as well as separate and stricter recommendations for the particularly sensitive people.

We see that calculated exposure at the nearest 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 biological and experience based recommendations for the general population.

Estimated exposure ($\mu\text{W}/\text{m}^2$)	AMS-Manufacturer	Frequency (MHz)	Exposure Limit ($\mu\text{W}/\text{m}^2$)		
			ICNIRP	EUROPAEM	
Bed pillow 1 to 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 17: Calculated exposure in bedrooms compared to ICNIRP based recommendations and to biologically based exposure limits
 (* The measurement result is unreliable due to the near field. See explanation below.)

Minimum distance, far field and near field

You have to measure and calculate the exposure at the right distance, 2 to 3 wavelengths from the antenna. The distance at which 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 use a higher frequency.

This fact may offer surprises: At shorter distances, both measurements and theoretical calculations become very unreliable. This happens because the radiation in the *near field* behaves quite differently from what it does 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, probably significantly more intense than can be deduced from the rule of thumb that intensity increases by a factor of four each time distance is halved. This rule applies to the *far field* only.

Therefore, there is considerable uncertainty about what the real exposure may be at the nearest pillow in the previous figure if you have a Kamstrup meter: The exposure may be significantly more intense than calculated because the pillow is in the near field.

In the corridor/hallway in the same house (Figure 18) we see that large parts of the hallway are within the near field. Hence, quantifying the exposure is an uncertain undertaking. Exposures of 16,000 $\mu\text{W}/\text{m}^2$ to 81,000 $\mu\text{W}/\text{m}^2$ or higher were calculated at distances of 0.9 and 2 metres respectively.

103 Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshhammer, 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. <https://www.degruyter.com/downloadpdf/j/reveh.2016.31.issue-3/reveh-2016-0011/reveh-2016-0011.pdf>

In many homes, you are within such distances from the meter if you stand by the front door chatting with your neighbour. You are then in the near field and cannot possibly know what the real exposure is where you are standing.

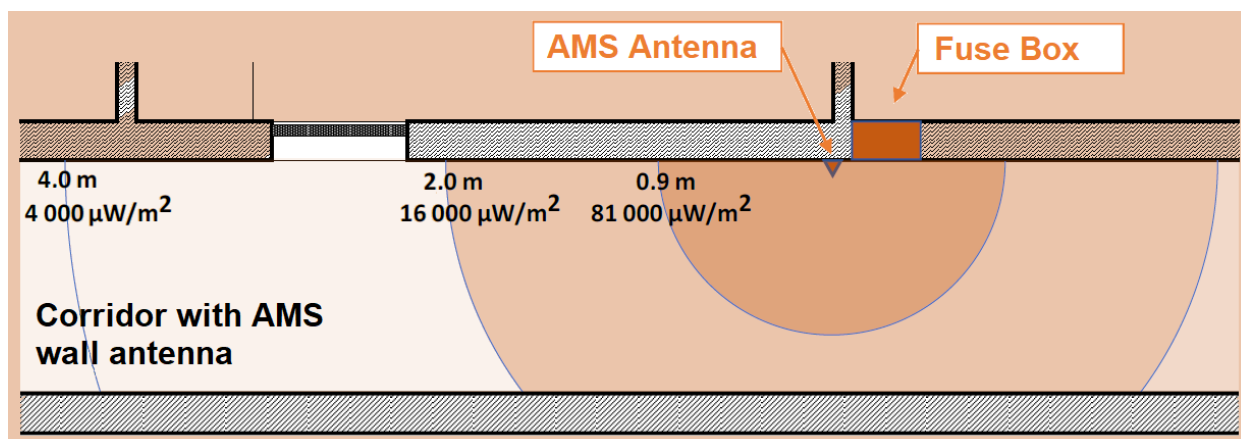


Figure 18: Calculated exposures and near fields depending of frequencies used by AMS-meter in corridor/hallway (J. Ravndal)

In the daytime, the EUROPAEM guidelines recommend exposure limits ten times higher than at night. Applied to the Ravndal corridor, EUROPAEM 2016 therefore recommends a limit of 10 µW/m². Norwegian governmental recommendations are as in Figure 17. So here too, there is huge distance between the calculated exposure up to the ICNIRP based suggested limits and down to the EUROPAEM based ones, as the table in Figure 19 shows.

We see that calculated exposure in the corridor is 27 to 61 times weaker than the Norwegian Radiation Protection Authority's ICNIRP-based limits, but 22,200 to 435,000 times stronger than EUROPAEM's biologically and experience based recommendations for the general population.

Exposures at the level recommended by EUROPAEM cannot be achieved with any microwave-based AMS/smart meter in such a situation.

Estimated exposure (µW/m²)	AMS-Manufacturer	Frequency (MHz)	Exposure Limit (µW/m²)	
			ICNIRP	EUROPAEM during the day
0.5m from AMS Antenna				
> 81,000	Kamstrup	444	2,220,000	100
> 81,000	Nuri, Aidon	870	4,350,000	10

Figure 19: Calculated exposure in corridor/hallway in relation to ICNIRP based exposure limits, versus the biologically based EUROPAEM recommendations at a distance of 0.5 m from the meter.

The calculated exposures are unreliable due to the short distance (near field).

Radiation from AMS/smart meters between floors

How much additional exposure will come from AMS/smart meters on adjacent floors? Ravndal also calculated the exposure from meters that are respectively one and two floors above (or below), still in a wooden building:¹⁰⁴

¹⁰⁴ Ravndal 2018-2, op. cit., see note 101.

Between floors, we see that when the meters are transmitting at full power, the exposure on the 1st floor from a meter on the 2nd floor is calculated to be 5,665 $\mu\text{W}/\text{m}^2$, and from a meter on the 3rd floor it is calculated to be 895 $\mu\text{W}/\text{m}^2$.

Again, without a table, we understand that the exposure is quite low compared to the Norwegian Radiation Protection Authority's ICNIRP based limits, but 900 to 5,700 times higher than EUROPAEM's recommendations for night-time for the general population. For particularly sensitive people, the exposures calculated are a further ten times higher.

Between adjacent homes, Ravdal's calculations show an exposure through the wall from the neighbouring home in a wooden house of 10,325 $\mu\text{W}/\text{m}^2$, measured at a distance of two metres. At a distance of 8 metres, which corresponds to a normal width for terraced house sections, the exposure was calculated to be 408 $\mu\text{W}/\text{m}^2$.

Also, these figures are directly comparable with ICNIRP based limits and EUROPAEM's recommended limits for daytime and night respectively. They are hundreds of times higher than EUROPAEM's recommendations, but far lower than the current Norwegian limits.

If the meters transmit weaker than their maximum permitted power, the exposure from the radiation will be correspondingly weaker.

Exposures at the level recommended by EUROPAEM cannot be achieved with any microwave-based AMS/smart meter in the home.

The exposure measured as power density is not a perfect yardstick

Note! Radiated power is a poor measurement unit for capturing biological effects. That is why EUROPAEM 2016 and other guidelines specify different recommended maximum values. They set them based on several criteria, including pulsation rate and clinical experience.

Health risks, including the likelihood of acute health problems, cannot be assessed without characteristics of the radiation other than the power density being taken into account. As we shall see in the research section, it has been shown that a wide range of properties other than the amount of energy over time have a significant impact on biological harm – whether acute effects or in the long term.

The Free Use Regulations do not capture the potential for damage

The Free Use Regulations¹⁰⁵ regulate radiation from AMS/smart meters and other devices. As long as you follow them, you are free to deploy transmitting equipment.

The Free Use Regulations set requirements for the equipment's radio technical characteristics. There is no reason to doubt that the requirements of the Free Use Regulations are met by the meters rolled out in Norway. The requirements for frequency, signal strength and time use are discussed in chapter 2.

The problem is that these regulations and the exposure limits do not provide satisfactory radiation protection, and are not made with such protection in mind:

The provisions on the transmission power are designed to, among other purposes, ensure that the current limits for exposure are not exceeded in normal use situations. But the way the limits are designed, they measure the heating potential, which is essentially an irrelevant factor in this context: It will hardly be possible to exceed these limits, except perhaps if you stand with your head

¹⁰⁵ Regulations on general permits for the use of specific frequencies (free use regulations), in Norway: FOR-2012-01-19-77

right up to the antenna. (With small antennas mounted in the hallways and stairwells of apartment blocks all over Norway, there has been plenty of opportunity for that.)

Pulses, from which research has long since demonstrated significant health effects even at very low values, do not affect the exposure measurements when carried out in the way these outdated procedures are designed: They are designed to measure the heating potential.

We have seen and will see that pulsing from microwave communication is a health problem, and the strength and biological impact from pulses seem to increase with each new generation of microwave technology.

The duration, which is regulated by the Free Use Regulations, is calculated in such a way that strong pulses can be sent more often than every second, i.e. in a biological sense; continuous around the clock and yet only last less than 2.5% of the day, because their duration is so short.

Neither is the situation of the users regulated in any relevant way: The users will frequently be within the *near field*, whether they sleep or sit there or stay there just temporarily. Hence, the calculations made by the relevant authority, NKOM, or which you can make yourself with simple measuring equipment are of no use there. The only thing you can know for certain, is that the electromagnetic fields are significantly stronger than measured than what the meters indicate.

For this reason, the Norwegian authorities' claims that the signals are so weak, also lack a basis, as the measurements are only relevant for the far field and we have seen that in practice both the sleeping pillow and the entire entrance may be in the near field, even in the near field of meter rooms, where a large number of AMS/ smart meters may be located.¹⁰⁶

The gap between the current regulations and exposure limits, on the one side, and guidelines taking into account the state of knowledge about pulsation and clinical experience, is huge and unjustifiable:

Exposures from AMS/smart meters are well within thermally based exposure limits, but sky high above the biologically based ones.

Added to this is the *unpredictability in that the software in the meters can be remotely upgraded and significant transmission parameters changed*. This means that significant changes can be made to important technical and other characteristics, such as communication methods and signal strengths and modulation, without residents being aware of this and without people who need it being able to take their own precautions.

Cases have been reported where such remote upgrading has changed communication parameters and caused serious health problems.¹⁰⁷

3.3 Use of AMS meters without radio communication

AMS meters can be used as traditional meters with manual reading if the radio communication is removed.

In the meters, the radio communication is a physically separate module that may be removed, or there is some other way that the radio transmitter can be deactivated by a hardware or software switch. The AMS meter is then "dead" in radio terms. For this and other feasible and practical solutions to reduce radiation, see chapter 12.

¹⁰⁶ Health complaints from people living in flats located next to the meter room have been reported several times by phone to the author, most recently before printing, on the 26/06/2018.

¹⁰⁷ Flydal, E: [An important experience at Telenor's customer centre in Fornebu](#), blog post, 24/02/2017

3.4 Additional equipment for "smart homes"

The AMS meters installed in Norway are equipped with a connector to plug in equipment within the "smart home" concept/"Internet of Things". The software in the meters is prepared for such extensions of use, which are expected to be mainly based on microwave radio communication.¹⁰⁸

In practice, this means that there will be various types of wireless (or in theory also wired) equipment offered that can be connected and used for various services for automating functions within the home. Connection of such equipment is optional and not further dealt with in this book. Generally speaking, such equipment will increase exposure to EMF in the home and in the immediate surroundings.

3.5 Studies on AMS and health, and other studies of relevance

Very little research has been done explicitly on AMS and health effects – other than reports from the industry and certain authorities. Such studies mostly demonstrate that the emissions are well below the limits, so they therefore conclude that this "cannot represent a health problem".

The research studies and reports we have found demonstrating health effects follow in a separate subsection. These are from other countries, which may use different technical solutions than the ones used in Norway.

However, there is still a lot of research that is relevant. In addition to these studies, there is every reason to believe that the large number of other studies on health effects from mobile radiation and other microwave-based communication systems are relevant also to AMS/smart meters, and that AMS/smart meters will show a similar clear correlation to health issues based on certain characteristics:

- AMS has greater signal strength (AMS meters are in Norway permitted under the Free Use Regulations to transmit at maximum power three times as strong as a 3G or 4G mobile phone). The maximum radiated power from the AMS meters is 820mW e.i.r.p. while from a mobile phone it is 250mW e.i.r.p.¹⁰⁹
- The modulation methods in 4G/LTE, TETRA and DAB have similarities, with strongly pulsating signal strength, while pulses from AMS/smart meters are stronger, steeper and continue 24 hours a day – subject to variations between different brands and versions.

In scientific research into biological effects from microwave communication systems other than AMS meters, there is ample evidence of risks of harmful effects both from mobile phone use, as well as from exposure to nearby mobile masts and base stations.

Studies on health effects of WiFi will also be relevant.

3.5.1 Studies of AMS/smart meters and health effects

Some studies that specifically refer to AMS/smart meters are briefly discussed here.

[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](#)¹¹⁰

A simple analysis of reported health effects based on exposure levels, where exposure levels are converted to the distance one must keep from the AMS meter to reach those same levels. The study

108 See for example the products of the company Wirepas, which supplies software for Aidon meters:

<https://wirepas.com/>

109 <http://emf-consult.com/emf-info/ams-strommaler/>

110 Paper, 11. June 11, 2013, https://skyvisionsolutions.files.wordpress.com/2013/06/powell-report-bioinitiative-report-2012-applied-to-smart-meters-and-smart-appliances_june_11_2013.pdf

shows that the level of exposure from AMS meters at all reasonable distances within a home can be linked to increased health risk. The picture drawn in this analysis must be corrected somewhat, as AMS meters in the USA seem, as far as we understand, to have a somewhat stronger radiated power.¹¹¹

[Lamech, F. \(2014\). Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: a case series.](#)¹¹²

A survey of health problems from smart electricity meters of residents in Victoria, Australia. The study finds that the complaints correspond to symptoms recorded in previous studies (the oldest from 1971) on microwave radiation. Most of the respondents had not previously been bothered by such symptoms and had not considered themselves to be electro-hypersensitive. The author interprets this as a sign that the smart meters may have properties that lower people's threshold for developing reactions.

[Pall, M. L. \(2015\). Microwave frequency electromagnetic fields \(EMFs\) produce widespread neuropsychiatric effects including depression.](#)¹¹³

Review study: Refers to 26 studies finding a connection between microwave radiation and a number of neuropsychiatric symptoms. Five criteria for interpreting the connection as a causal relationship are met. This overview study is mostly about health effects from mobile masts and base stations, but also includes two references to studies/investigations about AMS meters.

[Conrad, R.H. and Friedman, E. \(2013\). Smart Meter Health Effects Survey and Report.](#)¹¹⁴

Report on the findings of a survey of people from the US, Canada and Australia who reported health problems from smart electricity meters: "We found fourteen symptoms that many individuals suffered in common including ear ringing, headaches, difficulty concentrating, insomnia and heart arrhythmias. [...]" The report emphasises "both that many of our respondents (82%) were in good or excellent health before smart meters were installed and that overall, approximately 42% developed symptoms prior to any knowledge that meters were installed." [...] "Nearly 98% of respondents were very sure or fairly sure their new or worsened symptoms correlated to smart meter exposure."

[Halteman, E \(2011\). Wireless Utility Meter Safety Impact Survey: Final Results Summary.](#)¹¹⁵

Report from an American survey on health problems from smart electricity meters. The most common health problems reported were sleep problems, stress/restlessness/irritability, headaches, ringing in the ears (tinnitus) and heart problems. See Figure 20, which also uses data from an American survey not discussed here.¹¹⁶

[Report on the health effects of "smart meters"](#)¹¹⁷

Written by 6 doctors from Oregon, USA, based on medical literature. The report led to the city's authorities choosing to listen to the experts' warnings and adopt a precautionary policy.

111 Flydal, E: Smart about "smart meters" and health damage, 25.01.2016, <https://einarflydal.com/2016/01/25/smart-om-smarte-malere-og-helseskader/>

112 Lamech, F. (2014). Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: a case series <https://www.ncbi.nlm.nih.gov/pubmed/25478801>

113 <http://dx.doi.org/10.1016/j.jchemneu.2015.08.001>

114 <http://www.mainecoalitionstopsmartmeters.org/wp-content/uploads/2013/02/Exhibit-D-Smart-Meter-Health-Effects-Report-w-AppendicesV3-1-9Reduced-Appendices.pdf>

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

116 Figure 20 is from a presentation by Steven Weller, vice president Stop Smart Meters Australia, and member of Electromagnetic Energy Reference Group (EMERG) under Australian Radiation Protection & Nuclear Safety Agency (ARPANSA), may 2015, <https://stopsmartmetersau.files.wordpress.com/2015/06/steves-emerg-ehs-presentation.pdf>

117 Norwegian review: Flydal, E., [Straight talk from Oregon: six doctors against "smart" meters](#), blog post, 14/02/2017

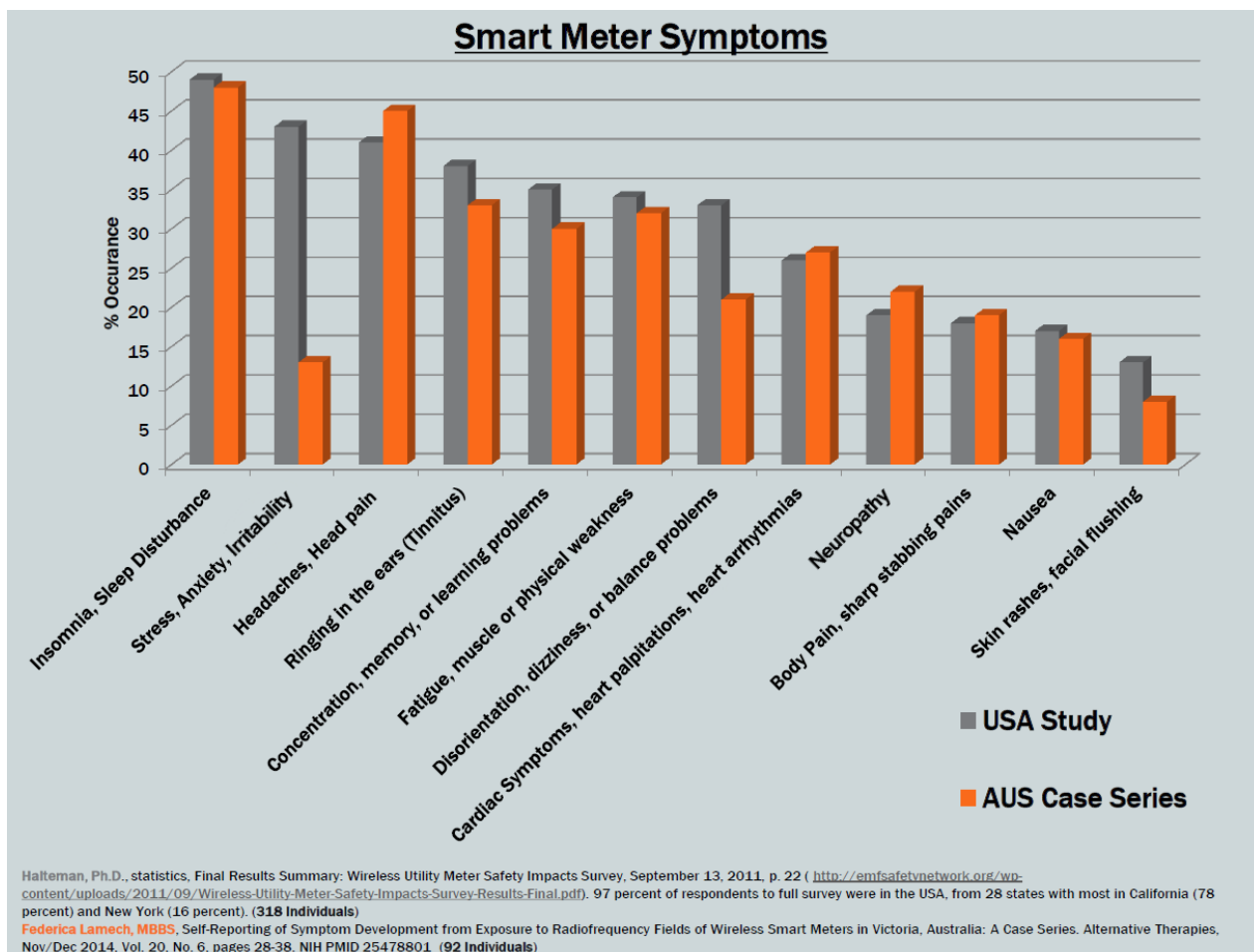


Figure 20: Typical AMS meter symptoms found in two surveys (Weller 2015)

3.5.2 Health and environmental effects in Norway from AMS meters

As far as we are aware, there is only one publicly available collection of descriptions of people's health-related reactions to AMS/smart meters in Norway.¹¹⁸ When collecting such stories halted in October 2019, there were 150 submitted reports, sent in by the victims themselves. Many of the submitters have chosen to anonymise their stories.

Some of the stories concern reactions to other EMF sources as reason for avoiding exposure to AMS/smart meters, but gradually, a significant proportion of the stories came to deal with health problems experienced closely related to the installation of AMS/smart meters. In fact, some of these stories are akin to blind tests: The symptoms occurred without the person affected knowing anything about smart meters, about being exposed, or about the possible health problems associated with them.

Extracts from a few stories are reproduced in a separate section in Chapter 2.

Naturally, relatively acute symptoms are so far the primary ones reported as effects from AMS meters in Norway, as the meters have only been in operation for a short time. However, the stories also report on the development of inflammation and symptoms that come on gradually.

¹¹⁸ Smart meter stories, <https://einarflydal.com/smartmaler-historier/>

Typical of many kinds of intolerances/hypersensitivity is "delayed reaction", meaning that reactions do not occur until the next day or even later. This too is reported, and substantiates that this is not about placebo effects or mass hysteria.

It is simply too early to investigate long-term effects, such as for example; cancer from AMS meter installations in Norway. The lead time for such disorders is often calculated to be 15 to 30 years, and by then there will have been new generations of technologies and other circumstances that make the interpretation of any long term study uncertain.

Therefore, mapping effects can present a number of methodological challenges due to the lack of control groups, new technologies, many other environmental toxins and cocktail effects. Evidence must therefore be obtained from other studies of similar technology.

This is what is done in the following chapter.

We will see that there are a number of research studies on communication systems based on similar technologies that demonstrate harmful health effects, both acutely and in the long term. We will also see that correlations have been mapped, both theoretically in laboratory experiments and in population studies. Also, several mechanisms of action have been demonstrated.

4. The big picture: Biological effects are well known

Modern scientific research into the reactions of humans and other living beings to electromagnetic fields began in the 1750s. To date, there has been an enormous number of studies produced.¹¹⁹ Some have estimated the number to be around 70,000. In today's medical research databases, you can find around 25,000 studies or more. A large majority of these demonstrate health-related reactions (see Figure 3 for recent studies). Over 1,000 research articles deal with therapeutic use – to achieve *health-promoting* reactions.

We know that all life, all chemical processes in humans, animals, plants and birds, down to the smallest bacteria, are based on electricity. Thus, we also know that there are theoretical possibilities for what electrical engineers refer to as *interference* – or simply disturbances.

Furthermore, we know that even extremely weak electromagnetic variations that occur throughout the day, out in the landscape or during animal movements, are utilised by biological systems – from the shells on the shore via insects and birds to humans and elephants. They are used for navigation, to warn of danger, to control the circadian rhythm (*the circadian system*)¹²⁰, to initiate various chemical processes. This is a simply practical and useful aspect of *interference*.¹²¹

It goes without saying that this use of electromagnetic fields by different life forms can be disrupted – with greater or lesser harmful consequences – by exposure to electromagnetic fields and radiation deviating from the patterns used by biological systems, whether the interfering electromagnetic fields are natural or man-made.

It has also been observed and documented countless times that among individuals, there is a wide range of variation with regard to sensitivity: Some people – who in our time are called *electro-hypersensitive* and previously had other designations¹²² – suffer acute health problems from exposures that are very much weaker than what others can tolerate unnoticed. This breadth of variation – that some are so sensitive while others are not – is still largely unexplained. Nor are the biological mechanisms well explained in purely physiological terms of how the reaction comes about, although there are several fairly detailed experiments demonstrating the effect.¹²³

In contrast, there is empirical evidence that high sensitivity can arise from both long-term low-level exposure (accumulated effect)¹²⁴ and from short-term high-level exposure.¹²⁵

Both these ways of causing symptoms are signals of hazard with relevance to the rollout of AMS/smart meters.

119 For an extensive popular scientific historical review, see Firstenberg, A, *The Invisible Rainbow - A History of Electricity*, 2017.

120 Flydal, E: [Facebook on the bedside table, the antenna on the wall – and the trees?](#), blog post, 19/03/2015

121 A classic providing an interesting introduction with a detailed overview of biomedical experiments and general theoretical understanding of this field is Becker, O. & Marino, A.A.: *Electromagnetism and Life*, 2010, 200 pages.

122 For other designations, see list in chapter 2, point 23.

123 Among other things, attempts have been made to explain the mechanism as analogous and linked to the mechanism behind MCS - multiple chemical hypersensitivity. Among electro-sensitive people, there are also many with MCS. A discussion of this explanation is found in a book that is both autobiographical and shocking, as well as academically strong: Crumpler, Diana: *Prostituting Science – The Psychologisation of MCS, CFS and EHS for Political Gain*, Inkling Australia, 2014

124 Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

125 Carpenter 2014, op. cit., see note 37



*Figure 21: Canaries were used to warn of dangerous gas in mines
(photo: Canadian Institute of Mining)*

Electro-hypersensitivity is also discussed in Chapter 2. In this part, electro-hypersensitivity is primarily interesting as a kind of "canary in the mine", a signal of hazard showing biology is also affected among those who may not even notice it.

A number of other such "canaries" have been observed over a long period of time – warnings of a connection between electromagnetic fields and changes in nature. For example, bees completely disappeared within two years from the island where Marconi set up his long-wave transmitter in the early 1900s, and since the United States Navy started up its global radio communications at the end of World War I, homing pigeons have suffered radically higher losses as so many of them are no longer able to find home.¹²⁶

New patterns of acute and permanent diffuse health problems arose among people with the introduction of electricity¹²⁷, and leukaemia among children increased in line with the expansion of the high-voltage power lines.¹²⁸ Several years ago stories started to spread that AMS/smart meters drive bees away.¹²⁹

These individual cases are "canaries" supporting in their anecdotal way the observation that electromagnetic fields have biological impact and are a significant factor increasing health risks.

Before, during and after both the First and Second World Wars, extensive research was carried out on electromagnetic fields and radiation of all kinds – in the Soviet Union, the United States and the German Third Reich. This research was partly open and internationally oriented¹³⁰, but also partly closed and military, as it was understood that electromagnetic fields could be used for military purposes in many ways. As well as being used for radar and radio communication, it also enabled

126 Firstenberg 2017, op.cit., see note 52

127 Firstenberg 2017, op.cit., see note 52

128 Milham, Samuel: *Dirty Electricity – Electrification and the Diseases of Civilization*, iUniverse, 2012

129 Bees Flee Smart Meters – Smart Meters are Hurting Bees, case report, <http://www.jamesrobertdeal.org/bees-flee-smart-meters/>

130 See, for example, the publication of Presman, A.S.: *Electromagnetic Fields and Life*, Springer Science, 1970, which was a collaborative project between professionals in the Soviet Union and the United States.

offensive weapons to be created to pacify or immobilise military crews¹³¹ or knock out entire countries by destroying computer equipment with "neutron shocks", i.e. strong electrical induction in the wiring network – i.e.; electrical interference.

The research was motivated by the dream of exploiting electromagnetic fields for the good of humanity, not just global military strategies,¹³² and it was motivated by specific technical needs – such as removing the noise that arose in military as well as civilian radio communication. Of course, there was also a strong driving force in market-driven economies such as in the United States to exploit the great business opportunities that presented themselves.

To date, a wide variety of pathways by which electromagnetic fields can affect physiology have been identified, even at extremely low levels of exposure, in the proximity of natural background radiation.¹³³

In a document such as this, we limit ourselves to selecting a few areas that provide insight specifically into health risks associated to microwave radiation. These are discussed in more detail in later sections.

We shall look at the discovery of morbidity patterns and the discovery of central mechanisms. Not the least as this applies to pulses, which were extensively researched before, during and after the Second World War because pulses in weather systems disrupted radio communication and needed to be filtered out. But they were also explored because it was understood they impacted people's health, as some individuals become ill when normal pulse patterns are disrupted.

Pulses with similar properties to those of weather systems are a distinctive feature of the radiation from modern digital microwave communications¹³⁴.

A wide range of research projects, from theoretical biophysics to *in vitro* and *in vivo* laboratory experiments, have confirmed the widespread adverse effects on health from low-frequency pulsed microwave radiation.¹³⁵

The vast expansion from military communications and radar to modern mass communications has increased the impact of microwave radiation on all forms of life. This is now reflected in documented adverse effects on nature¹³⁶ as well as in the new picture of disease, where health problems that were previously rare and only found in certain individuals, have become far more widespread in the population.¹³⁷

131 Capt Paul E Tyler: The electromagnetic spectrum in low-intensity conflict, i David J (editor) Dean: Low-Intensity Conflict and Modern Technology, United States Government Printing (June 1986)

132 Schjelderup, Vilhelm: Electromagnetism and life - a confrontation between two superpowers of science, 1987

133 Horsevad, Kim: Mapping Bioreactivity for Microwaves in Nonthermal Intensities, Saxo, 2015, (in Danish) can be ordered from Akademika or downloaded here:

http://helbredssikker-telekommunikation.dk/sites/default/files/Kortlaegning_af_Bioreaktivitet_ved_Mikroboelger_i_non-termiske_Intensiteter—2015.pdf

134 Sønning, Walter: Sensitivity to the weather and electrosensitivity, research reports on the effects of electromagnetic fields, competence initiative e. V., 2013, <https://kompetenzinitiative.com/wetterfuehligkeit-und-elektrosensibilitaet/>

135 See i.a: Panagopoulos, Dimitris J., Karabarounis, Andreas and Margaritis, Lukas H.: Mechanism for action of electromagnetic fields on cells, Biochemical and Biophysical Research Communications 298 (2002); 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;

136 For summaries and references, see e.g. Firstenberg, A, The Invisible Rainbow - A History of Electricity, 2017; Flydal, Einar: Kunnskapsstatus v. 1.02, paper , 2016,

<https://einarflydal.files.wordpress.com/2016/08/kunnskapsstatussemf-eflydal09082016-v1-02.pdf>

137 Firstenberg 2017, op. cit., see note 52

4.1 Research in the Soviet Union: Long-term studies

In the Soviet Union since the 1950s, extensive research into EMF and biological impacts has been ongoing, both with regard to working life, space research, utilization in therapy, and for the protection of the population in general.¹³⁸

The findings, which were made through extensive animal experiments and observations of people over a long period of time, fit in with the research done in the West, and the list of physical and psychological (neuropsychiatric) symptoms – acute as well as long-term – fits well with the descriptions that are given since the 1750s by various researchers.¹³⁹

These Soviet Russian findings were, among other things, that *although acute effects are found, they are not the norm, while long-term effects are foreseeable in a large proportion of those exposed:*

The long-term effects thus constitute a significant volume to which great importance must be attached for public health as a whole. Below are keywords from typical long-term effects. These effects were in various scientific investigations found in various scientific investigations a prevalence (proportion of occurrence) in 55% to 91% of the observed personnel after long-term exposure of 5 to 10 years:¹⁴⁰

Neurasthenia, the autonomic nervous system, vagotonia, sensory-somatic disorders, CNS and the autonomic nervous system, concentration and memory loss, chronic headache, depression, sleep disorders, tremors, tinnitus, hair loss, sensorimotor disorders, chronic fatigue, disturbances of the circadian rhythm, body temperature and heart rate, cardiovascular disorders, hypotension, hypoglycaemia, tremors in the fingers.

The findings apply to reactions that occurred during exposures well below "thermal values". These findings were made in the 1960s and 1980s, at a time when limits practised in the West were ten times higher than today's limits, which are the IEEE and ICNIRP guidelines of 1996 and 1998, respectively. The Soviet findings were well known in the West and referred to during the many microwave conferences held.¹⁴¹ [In 2020, ICNIRP released new guidelines, more lax than those from 1998.]

Based on their findings, limits for exposure were set in the Soviet Union and in some Eastern Bloc countries to protect against both acute and long-term effects, and they were set from a precautionary perspective. These limits for exposure are more nuanced than those that were eventually set in the West and also therefore not directly comparable. As shown in Figure 1, they are in the order of 100,000 $\mu\text{W}/\text{m}^2$ for the general population against the West's 10,000,000 $\mu\text{W}/\text{m}^2$,¹⁴² i.e., around one hundredth and lower.

4.2 Research in the West: Short-term studies

In the West, there have been very few long-term studies, and many short-term studies based on relatively simple, practical models, particularly related to the military. Based on the above, this implies that they are less reliable:¹⁴³

138 The results are extensively documented in Hecht (2016). Health implications of long-term exposure to electrosmog, Kompetenzinitiative e.V., 2006, https://kompetenzinitiative.com/wp-content/uploads/2019/08/KI_Brochure-6_K_Hecht_web.pdf (Link updated 31.1.2023)

139 Firstenberg 2017, op. cit., see note 52

140 Hecht 2016, op. cit., see note 138

141 Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

142 Hecht 2009, op. cit., see note 141

143 Hecht 2009, op. cit., see note 141

In research in the Soviet Union, it was quickly concluded that testing for short-term effects did not give reliable answers, nor did it give answers as to whether harmful effects had to be expected over time.

An important reason lies in the fact that the body is a *complex, dynamic system*: It will try to counteract the impact when put under pressure from outside. It may resist for a long time, perhaps several years, before the pressure becomes too high. (See Chapter 2, under *Interference*.)

Hence, short-term trials provide unreliable information on effects. In the Soviet Union, a number of long-term studies were therefore carried out in addition to short-term studies and theoretical work.

The investigative journalist Poul Brodeur describes how long-term studies financed by the military, which were the most important source of funding for US research in the area, were halted or prevented when significant correlations were found.¹⁴⁴ Thus, they very rarely got the repetitions of the experiments needed to confirm or debunk the findings made.

Nonetheless, a lot of research has been done, including some long-term studies of animals and humans. Overview studies and individual studies are discussed in later sections of this book.

4.2.1 Complexity, causal models and presentation of evidence

In order to understand the state of knowledge in the field of biological effects of microwave radiation, it is important to realise that when conducting empirical studies – i.e. acquiring significant parts of the knowledge not only through logical thought processes, but through observing the real world, one is facing biological systems that are extremely complex and only partially understood. This applies even when relationships can be clearly demonstrated, for example between exposure to an environmental toxin and morbidity.

This is quite normal for patterns where many reasons – for example; different environmental toxins – interact and reinforce each other (see chapter 2, Cocktail effects). It is also normal for living organisms, including humans, to try to defend themselves or adapt or counteract the impact, for example; by regulating body temperature or by producing oxidants or antioxidants. This happens through complex biological and biochemical processes. The result may be so successful for the organism that by the time it is examined, the impact may be concealed from the researcher.

Furthermore, it is normal that when basic biological processes are disrupted, a threshold (see chapter 2, points 16 and 17) may suddenly be exceeded and that the effects may appear very differently in one individual from the other in very different ways (as a result of a *many-to-many relationship* between causes and effects and complex chain reactions).

It is also normal that relationships observed, e.g., between exposure and reaction, are not *linear* and *positive* (i.e. of the type "the greater the dose, the greater the effect"). Instead, it is normal that the relationship may assume very different forms, including so-called "window effects", where one may see for example, a very weak exposure having a stronger effect – up to a certain limit – than a strong exposure, or a very weak exposure having a positive effect while a stronger dose has a negative one (called *hormesis*).

The fact that the interrelationships are so complex means that it becomes very complicated to explore and understand causes and effects, and that one therefore often has to rely on statistics or individual observations as a basis for action, without having any complete understanding nor having provided unassailable evidence.

Not least, this means that there is plenty of room for error, even with the best and most honourable intentions, i.e., not finding connections even if they are there or finding false connections that are not there.

¹⁴⁴ Paul Brodeur: *The Zapping of America*, Norton & Co, N.Y., 1977

In principle, research-based knowledge is created when findings that have been made are criticised for shortcomings, and with that as a starting point, further research is carried out towards new knowledge that is more robust to criticism. And so it continues in an eternal spiral. Along the way, of course, various procedures are used to ensure that studies are repeated in different environments, subjected to criticism, etc., etc.

Studies that find nothing do not count

It is the studies that find correlations without showing significant weaknesses that are to be emphasised when research is assessed. These are the ones where you look for mistakes to criticize and to build further on by finding improvements. These studies are the important ones – and they are all the more robust the more they are strengthened by other studies with similar findings, or in other ways supporting them.

The other studies – i.e. the studies that do not find correlation patterns – are not given weight, even when they are in the majority: Because when studies do not find anything, this might have so many reasons – whether the formulation of the research, the methodology or not looking in the right place, or for other reasons. The world is full of studies that find nothing. They carry no weight and are not valid as evidence as long as there exists other studies that do make findings without having significant flaws. These are the ones that count.

If one is to claim that studies finding patterns – i.e. correlations or other patterns, should not be taken into account, one must therefore demonstrate that they are tainted with errors that are so significant that the findings have to be disregarded. Doing so is a demanding process, and a process that might be full of discretion: For example; the assessment should be different depending on how consequential it is to exclude a finding that might be right after all. (Here the precautionary principle and other considerations might come into play.)

Another reason why those studies that find nothing don't count, is that it is so easy to design studies so that you don't find anything, by intention or not. And this happens, as we will see later. Studies shaped so that false findings are made are more easily exposed.

This first selection process of sorting out research making no findings, is just a first step, as it applies only to the weakest form of evidence, that which consists in providing evidence by referring to studies that make similar and positive findings. The philosopher of science Karl Popper taught the world to evaluate knowledge and evidence.¹⁴⁵ Here is his *hierarchy of scientific evidence*, with examples below created for this occasion:

1. The strongest argument is *information demonstrating that a theory must be wrong*:

“The calcium channels in the cell membranes have sensors that amplify the energy supplied from the outside by a factor of 7.2 million, which means that oxidation damage from supplied calcium in the cells is triggered by far weaker exposure than what is needed to create heating from microwaves.”

If the information in this statement is correct, it proves wrong that health damage cannot occur from exposure that is too weak to cause heating.

145 Popper, Karl: *Conjectures and Refutations: The Growth of Scientific Knowledge*, 1963, mentioned in 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, <https://www.degruyter.com/document/doi/10.1515/reveh-2015-0001/html>

2. Next come "*bold predictions*", predictions that follow from one hypothesis and which would not follow from other hypotheses:

"Many people will get a headache if they go into meter rooms in apartment buildings where there are many smart meters with radio communication, and they will get it even in a double-blind trial where no other causes can be demonstrated, for example noise or bad air."

If this happens during experiments, it has been proven that it is wrong that health damage cannot occur at exposures too weak to cause heating – *to the extent that no significant sources of error are found.*

3. Last in Popper's hierarchy of evidence come *confirmatory studies*, i.e. studies that make discoveries that support the theory. But since such findings can always support a number of different hypotheses, they are the weakest form of evidence of the three:

"Ten different studies found that people got headaches when staying near a smart meter."

This finding – that is, the ten studies combined – proves that it is wrong that damage cannot occur from exposures too weak to cause heating only to the extent that these studies exclude the possibility of a number of other causes for the headaches – which would be hard to exclude completely.

When evaluating research and research reviews, it is therefore important to look at whether the evidence presented is of Popper's type 1, 2 or 3.

The research presented to support claims that exposures below the threshold values also increase health risks is generally of types 1, 2 and 3.

Those who defend today's ICNIRP-based limits, on the other hand, emphasise the research that is of a "type 4" that Popper did not even find worthy to include in the hierarchy of evidence because it is not a valid scientific possibility: Studies used to give "support" to the claim that there is nothing to find because they did not make any findings.

Thus, the Norwegian National Radiation Protection Authority argues in a critique of this author that it is just such studies – which do not make findings of "non-thermal" effects, that confirm that the limits are set at responsible levels. (SIC!)¹⁴⁶

- "Among other things, he [i.e. this author] chooses to ignore documentation finding no connection between EMF and health problems", says Kofstadmoen.

This is the type of unscientific and distorted argument that in its time was systematically cultivated by the PR industry to protect the interests of the tobacco industry. This is described in detail in the literature on "tobacco research" as a deliberate strategy. It is also this type of argument that dominates in the committees from which the Norwegian Radiation and Nuclear Safety Authority builds its knowledge base. We will return to this in chapter 10.

4.2.2 Reviews of the state of knowledge in scientific EMF research

Knowledge reviews are considered the "gold standard" in research. They provide an overview of large amounts of scientific research and shall ensure that the interpretation of it is consistent. Knowledge reviews are in many ways replacing the earlier discussions within small academic

¹⁴⁶ Barstad, Haakon: "Flydal's skewed starting point", interview with director Hanne Kofstadmoen, Norwegian Radiation Protection Authority, in the industry magazine Energi, 06 2018.

communities, where consensus was reached as to what was to be considered "true knowledge" – or at least the valid knowledge – within the field.

Of course, the high complexity and interdisciplinary nature also provides ample opportunity for knowledge to be forgotten. This happens repeatedly within all areas of knowledge – until the knowledge is rediscovered. This is how the biological effect of *pulsing* and *Brillouin precursors* (see Chapter 2) were forgotten in the technological communities, in industry and in radiation protection circles. Now it is slowly being brought back to life because the effects have moved closer to so many people.

"Sticking your finger into the ground" to see where you stand and whether you are looking in the right place is therefore something everyone needs to do once in a while. In research, this takes the form of research literature reviews that conclude on what can be considered to be the state of knowledge.

Research reviews not only provide good opportunities to find out what is known in a field, but also offer plenty of opportunities to play strategic games that gamble on the fact that few have an overview of the field and even fewer are familiar with the details or actually read more than the summaries of such reports. Evaluating research, as committees constantly do, can therefore easily become a strategic game where any desired conclusion can be substantiated, as long as you know where you want to go and select the right sources to underpin your conclusion. In such cases, report preparation becomes a game for bureaucrats and other stakeholders who want to promote specific views.¹⁴⁷

Committee work is also often a source of income and an interesting source for professional overview and networking.

Research criticism is also an arena for the most stubborn, those who have specialised in what is the heart of the knowledge process – finding weaknesses in other people's research, and then using these as a platform for their own studies to better match the "facts on the ground". There is nothing illegitimate in this, only a recognition that such tasks also appeal to certain personalities.

The total volume of "modern" research studies in the area of electromagnetic fields and biological effects is well over 25,000. A clear majority find connections between exposure and health effects (see below).

This weight of research finding links between exposure and health effects is confirmed by the most recent broad review of published research (obtained from the Medline database) for the period 1990 to December 2017 (Lai 2017). The results are shown as graphs in figure 22. They show a clear majority of findings of harmful effects in all investigated areas.

A review of a British database of research studies, sorting the articles according to whether they make positive findings or not, shows similar results.¹⁴⁸

It is simply the fact that in several important areas there is a significant majority of published studies showing significant harmful or potentially harmful effects at "sub-thermal" levels of exposure.

147 See e.g. Bjørkdahl, Kristian: "The influential neutrality - The report as democracy's rhetorical journey", and Tellmann, Silje Maria: "Norway's public investigations - between research and politics" in Bjørkdahl, Kristian (ed.): *The report - genre and management tool*, Pax, 2018

148 Powerwatch, <http://www.powerwatch.org.uk/science/studies.asp>

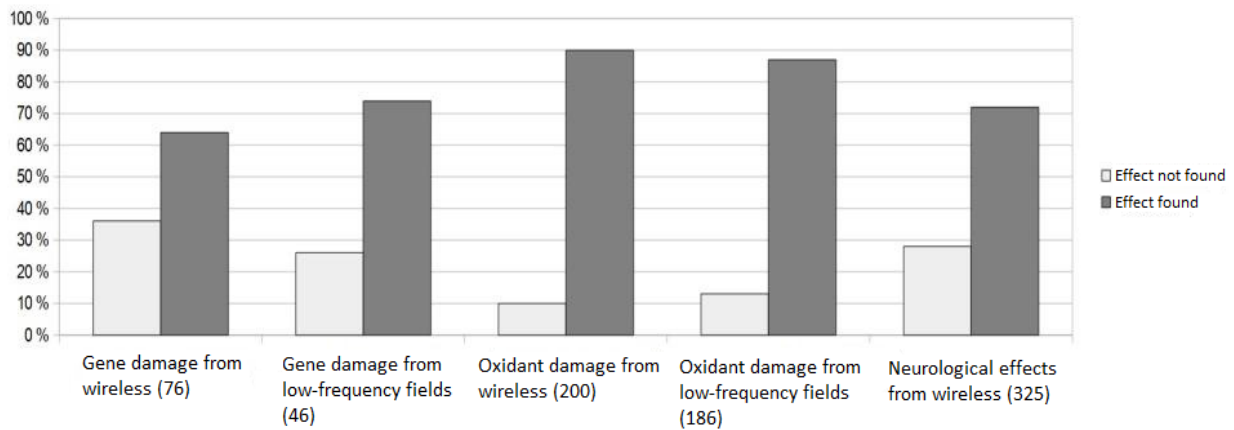


Figure 22: A clear majority of studies find damage below the exposure limits (Lai 2017, also used as Figure 3)

Mentioned below are a number of reviews that provide a fairly consistent picture of biological impacts and harmful effects below "thermal levels", conforming with the mainstream of research as shown in figure 22. The references include both major scientific reviews and references to less heavy walk-throughs of the research. They have been selected to show both scope and breadth:

- For a comprehensive historical and popular broad review of studies from the 1750s to the present day, with a 150-page bibliography, see Firstenberg 2017.¹⁴⁹
- For a detailed, professional review of biophysical research in the field in Europe (Western and Eastern) as well as the USA up to the end of the 1960s, see the large research review by A. S. Presman on behalf of the Soviet Academy of Sciences from 1968, "Electromagnetic Fields and Life". The book was translated into English and published in New York in 1970 (Presman 1970). It is a large work with just over 650 references – including Russian, German, Polish, American, i.e. from the leading research communities at the time.¹⁵⁰
- For an English-language comprehensive peer-reviewed review of approximately 7,000 articles from international research up to 2012, see the BioInitiative Report 2012.¹⁵¹
- For a new Norwegian-language, annotated collection of references and links to research and other literature that demonstrates harmful effects on health, as well as to professional literature databases, resolutions and recommendations to authorities, see Kåss & Halmøy 2018.¹⁵²
- For a short article in Norwegian addressing a larger audience, with an introduction to some of the most important damage mechanisms as well as an overview of the research results on the health effects of microwave radiation, see E Flydal 2018.¹⁵³

149 Firstenberg, Arthur: "The Invisible Rainbow – A History of Electricity and Life", AGB Press, 2017

150 Presman, A.S.: Electromagnetic Fields and Life, Springer Science, 1970.

151 BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Radiation, www.bioinitiative.org, December 31, 2012. (Peer review took place per chapter after publication online.)

152 Kåss, Ingrid Wreden & Halmøy, Sissel: Harmful effects of radiation from wireless technology and other EMF are well documented - Source collection: Research and warnings from the field, memo, Folkets strålevern, 25/05/2018,

153 Flydal, Einar: Electromagnetic radiation - are we gambling with our children's health?, article in Critical views of the school, Z-forlag, 2018

- For a Norwegian-language, annotated memo on the state of knowledge, with emphasis on general effects on nature and the environment from microwave radiation, see E. Flydal 2016.¹⁵⁴
- For an impression of the amount of research in the field, see the titles in the personal collection of historian Nicholas Steneck, University of Michigan, within the field of radiation for the period 1964-85, deposited into the Gerald Ford Museum.¹⁵⁵
- For a German-language review of the main features of research findings throughout the 20th century and the rationale for the Soviet Union's exposure limits, see the popular scholarly account by one of the doyens of East German and Soviet Russian research, Karl Hecht.¹⁵⁶
- For an idea of the amount of research studies that have been available within US defence circles, see e.g. Zorach, R., & Glaser, 1971.¹⁵⁷

There are a number of academic research reviews (meta studies) on more limited aspects of the field. These can be found in the sources above.

All of these sources confirm that significant health effects occur at "sub-thermal" exposure levels. They contain positive findings, i.e. find associations between exposure and adverse health effects and/or increased health risks – at exposure levels below the current limits.

4.2.3 Key areas of morbidity

Those harmful effects from EMF exposure below the limits appearing to be the most solidly substantiated by science, are the following (some of the categories partially overlap):

- Genetic/DNA damage
- Nervous system damage
- Oxidative stress, with a range of consequences, such as changes in calcium signalling in the nervous system, impaired energy production, sleep problems and reduced DNA repair, inflammation, reduced immune system.
- certain forms of cancer
- Damage to fertility
- Neuropsychiatric symptoms
- Various acute symptoms (often referred to as electro-(hyper)sensitivity)

Even just one single compilation study – The BioInitiative Report (mentioned in the previous section) – deals with more than 7,000 studies where symptoms of the kind listed above can be linked to exposure to electromagnetic fields weaker than the current ICNIRP recommendations. This study and other collective studies make it reasonable to expect health damage and ailments from the radiation from AMS/smart meters.

154 Flydal, Einar: Knowledge status: - Man-made radiation threatens the living environment, memo, Einar Flydal, 09 August 2016, <https://einarflydal.files.wordpress.com/2016/08/kunnskapsstatusemf-eflydal09082016-v1-02.pdf>

155 <https://www.fordlibrarymuseum.gov/library/guides/findingaid/steneckresearchm.asp>

156 Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

157 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://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB83176537.xhtml>

The lead time before effects may occur varies greatly, from seconds for some reactions like nausea or "brain fog", to several decades in the case of; cancer and certain neuropsychiatric disorders (ALS, Parkinson's, Alzheimer's).

Acute symptoms have been observed since people began experimenting with electricity (circa 1750), and later developed networks for telegraphy and electrical power in the cities. Acute symptoms have been observed from the earliest civilian and military use of radio technology.¹⁵⁸

The explanation of *weather sickness* given elsewhere in the book makes it understandable and reasonable that acute reactions to microwave radiation can produce extremely different symptoms. The explanation is related to low-frequency pulsation, which is fundamental to microwave communication. Its causation pathways will, for biological reasons, have varying effects on different individuals. See Section 4.2.6.

While today the acute effects from AMS/smart meters are the ones receiving attention and provide legitimate reasons for exemption, it may well be the case that long-term effects will cause the greatest harm to health. Such a concern may be underpinned by of the Soviet long-term studies. These are mentioned under electrical sensitivity, Chapter 2, and here in Chapter 4.

4.2.4 Studies documenting scientific findings

Just a few examples of research studies are referred here – individual studies, meta-studies and bibliographies alike within the topics mentioned in the previous section. For more complete overviews, please refer to bibliographies and databases.¹⁵⁹

[The BioInitiative Report – A Rationale for Biologically-based Exposure Standards for Low Intensity Electromagnetic Radiation.](#)¹⁶⁰

In 2012, the BioInitiative Group published its summary of findings drawn from a large number of published studies. Among other things, the report concludes that much stricter limits are needed to protect people (especially children), animals and nature against the harmful effects of electromagnetic fields. The report was prepared by 29 specialists from 10 countries. Ten of them have medical degrees (MD titles) and 21 have doctorates (PhDs). *Among the authors were; the chairman of RNCNIRP (The Russian National Committee for Protection against Non-Ionizing Radiation), a senior adviser at the European Environmental Agency (EEA) and 3 former presidents of the Bioelectromagnetics Society.* Reports/abstracts have been peer-reviewed and published. (The first edition appeared in 2007. Peer-reviewed abstracts were published in *Pathophysiology* in 2009.)

The report has had several additions since 2012. A few of those, providing parts of the data for the columns in Figure 22, are:

[Genetic Effects of Non-Ionizing Electromagnetic Fields, Supplement, 2014](#)¹⁶¹

[Neurological Effects of Non-Ionizing Electromagnetic Fields, 2014 Supplement](#)¹⁶²

[Falcioni et al. \(2018\). Report of final results regarding brain and heart tumours in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission](#)¹⁶³

158 Firstenberg 2017, op.cit., see note 52

159 The overview in this point is mainly taken from Kåss and Sissel Halmøy op.cit., see note 152. See also Powerwatch op. cit. and Flydal, E: Knowledge status 1.02, 2016

160 <http://www.bioinitiative.org/>

161 https://bioinitiative.org/wp-content/uploads/pdfs/sec06_2012_genetic_effects_non-ionizing.pdf For a review in Swedish: <http://www.stralskyddsstiftelsen.se/2014/04/fullt-bevisat-att-mobilstralning-skadar-hjarnceller/>

162 https://www.bioinitiative.org/wp-content/uploads/pdfs/sec09_2012_Evidence_Effects_Neurology_behavior.pdf

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

This study, from the Italian Ramazzini Institute, finds significantly increased cancer development in the heart of rats exposed to radiation from mobile phone base stations. The study also finds an increased incidence of brain tumours. The findings of the study confirm the main findings of the large US government [NTP study](#).

[Actions from Peer Review of the Draft NTP Reports on Cell Phone Radiofrequency Radiation, 2018](#)¹⁶⁴

A government-appointed panel of experts in the USA states that there is "clear evidence" for a link between mobile phone radiation and malignant heart cancer in rats, after reviewing the world's largest animal study (at \$25 million) from the prestigious National Toxicology Program, 2018. They also find some evidence that exposure promotes other types of cancer, including malignant brain cancer and cancer of the adrenal glands to a greater extent in the exposed group of experimental animals than in the control group. The findings are also confirmed in several other studies.¹⁶⁵

The expert panel found, among other things, that the data in the study shows clear evidence for carcinogenicity from mobile phone radiation for a type of tumour in the brain (schwannoma=nerve tumour, in the brain linked to mobile phone use). They also found evidence for malignant brain cancer (glioma) in exposed males. The findings applied both to exposure from GSM-modulated and CDMA-modulated mobile phone radiation, at radiation levels to which people may be exposed.

In addition, inconclusive evidence was found for a number of other types of cancer, as well as other harmful effects such as a significant increase in DNA damage in certain parts of the brain of exposed rats. An increased degree of heart defects, lower birth weight and higher mortality were also found in exposed newborn rat pups.

Even before the project ended in 2017, the scientists issued a warning that it is time for a stricter cancer classification for RF radiation from wireless technologies.

There has been strong and detailed criticism of the NTP study, suggesting among other things, that the control groups in the trial were also significantly exposed, that the effect of exposure to microwave radiation is therefore *understated*, rather than exaggerated, and also that *the effect on cancer incidence and other harmful effects is not only or mainly correlated with power density ("signal strength")*. This means that there are other causes from the radiation apart from power density that are important for morbidity, even when power density keeps being used as the explanatory factor.¹⁶⁶

[Overview Study: Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation, Yakymenko et al 2016](#)¹⁶⁷

This meta-study (Yakymenko et al. 2016) shows that *93 out of 100 available published studies find that radio frequency radiation (such as from mobile phones and other wireless technologies) causes a significantly increased incidence of oxidative stress in biological cells*. Furthermore, the study shows extensive evidence of how this is connected to a range of adverse biological effects and harmful effects, including DNA breakage and cancer development. Oxidative stress is an imbalance between the antioxidants and the free radicals in the body, resulting in an unbalanced production of peroxides and free radicals (or reactive oxygen compounds also called Reactive Oxygen Species,

164 https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/actions20180328_508.pdf

165 See review with statements from several of the panel members: <https://ehtrust.org/clear-evidence-of-cancer-concludes-the-expert-panel-to-the-us-national-toxicology-program-on-cell-phone-radiation-study-findings/>

166 Firstenberg, Arthur: Report on National Toxicology Program's Cell Phone Study, notat 19.4.2018, <http://www.cellphonetaskforce.org/wp-content/uploads/2018/04/NTP-analysis.pdf> og NTP analysis – Part II: design flaws and conclusions, notat 20.4.2018, <http://www.cellphonetaskforce.org/wp-content/uploads/2018/04/NTP-analysis-Part-II.pdf>

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

ROS) that destroy cells and DNA (genetic material). This type of damage is called *oxidative damage*. When oxidative stress occurs, the body's natural defence mechanisms are no longer able to adequately prevent or repair the damage. Over time, this leads to illness. Oxidative stress is considered to be an important contributory causal mechanism in many serious diseases.

[Large cohort study: Birks et al \(2017\): Maternal cell phone use during pregnancy and child behavioural problems in five birth cohorts](#)¹⁶⁸

The study found an increased risk of behavioural problems in children whose mothers had (moderate to) high mobile phone usage during pregnancy: "Evidence for a trend of increasing risk of child behavioural problems through the maternal cell phone use categories was observed for hyperactivity/inattention problems (OR for problems in the clinical range: 1.11, 95%CI 1.01, 1.22; 1.28, 95%CI 1.12, 1.48, among children of medium and high users, respectively). This association was fairly consistent across cohorts and between cohorts with retrospectively and prospectively collected cell phone use data."

[Hecht \(2016\). Health implications of long-term exposure to electrosmog](#)¹⁶⁹

This report by Prof. Dr. med. habil. Karl Hecht, addresses among other things, the findings of 878 Russian-language scientific studies – both military and civilian – dating from 1960 to 1997. It refers to findings of harmful effects on the central and sympathetic nervous system, as well as a number of neuropsychiatric effects. The findings are confirmed in both older and more recent American and Western European studies. The report has been translated from German to English and includes updates.

[Pall, M. L. \(2013\). Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects](#)¹⁷⁰

Overview study: A number of peer-reviewed published studies have shown that both high-frequency and low-frequency electromagnetic fields can affect biological cells by opening the cells' voltage-gated calcium channels. This in turn can lead to changes in the cells' calcium signalling, oxidative stress, DNA damage and eventually to several other adverse health effects. The findings of the mechanisms are confirmed by several studies showing that adding known calcium channel blockers stops these effects.

[Pall, M. L. \(2015\). Microwave frequency electromagnetic fields \(EMFs\) produce widespread neuropsychiatric effects including depression](#)¹⁷¹

Review study: Refers to 26 studies that find a connection between microwave radiation and a number of neuropsychiatric symptoms, and that five criteria to prove causality (causal relationship) are met.

[Pall, M. L. \(2018\). Wi-Fi is an important threat to human health](#)¹⁷²

Review study: "Repeated Wi-Fi studies show that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis (cell death), cellular DNA damage, endocrine changes and calcium overload. Each of these effects may also be caused by exposures to other types of microwave frequency EMFs, with each such effect being documented in from 10 to 16 review studies. Therefore, each of these seven EMF effects are established effects of Wi-Fi and other types of microwave frequency EMFs". The study also states that the most important mechanism of action behind the harmful effects is known and well established.

168 <https://www.ncbi.nlm.nih.gov/pubmed/28392066>

169 https://kompetenzinitiative.com/wp-content/uploads/2019/08/KI_Brochure-6_K_Hecht_web.pdf

170 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3780531/>

171 <http://dx.doi.org/10.1016/j.jchemneu.2015.08.001>

172 <https://www.ncbi.nlm.nih.gov/pubmed/29573716>

[Warnke, Ulrich: Bees, birds and mankind – Destroying Nature by ‘Electrosmog’, 2009](#)¹⁷³

Popular academic report published by a leading expert. Contains a very comprehensive reference list of published, peer-reviewed research studies. A particularly good popular introduction to the use by birds, insects and other animals of electromagnetic fields for orientation, navigation and communication, as well as how man made production of EMFs disturbs nature.

[Balmori A \(2015\). Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation](#)¹⁷⁴

Details how radiation from mobile masts etc. has been shown to interfere with the orientation ability of several bird species.

[Sivani & Sudarsanam. \(2012\). Impacts of radio-frequency electromagnetic field \(RF-EMF\) from cell phone towers and wireless devices on biosystem and ecosystem – a review](#)¹⁷⁵

Review article discussing a number of adverse effects that are well documented in scientific literature: "Based on the currently available literature, it is justified to conclude that RF-EMF [i.e. radio frequency electromagnetic fields] radiation exposure can create changes in neurotransmitter functions, the blood-brain barrier, morphology, electrophysiology, cell metabolism, calcium efflux and gene expression in certain types of cells even at lower intensities".

[Cucurachi et al. \(2013\). A review of the ecological effects of radiofrequency electromagnetic fields](#)¹⁷⁶

The review shows that two thirds of 113 available peer-reviewed studies showed harmful effects on the ecosystem.

[Manville, II, Ph.D. \(2016\). A Briefing Memorandum: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife](#)¹⁷⁷

Expert opinion that argues for immediate action due to detrimental impact on wildlife from man made EMFs.

[Halgamuge \(2017\). Weak radiofrequency radiation exposure from mobile phone radiation on plants](#)¹⁷⁸

This is a review of 45 peer-reviewed, scientific studies involving 169 experimental observations to investigate the reactions of plants when exposed to radiofrequency radiation below our exposure limits. 89.9% of the studies showed statistically significant effects on plants.

[Huss, A., Peters, S. and Vermeulen, R. \(2018\), Occupational exposure to extremely low-frequency magnetic fields and the risk of ALS: A systematic review and meta-analysis](#)¹⁷⁹

From the [Swedish version](#)¹⁸⁰ of the study: "The risk of ALS due to the elevated magnetic field at the workplace is +14%. For those who work in the electrical profession, the risk is increased by 41%. The highest risk was seen in studies taking into account the combined total exposure of low-frequency magnetic fields (+89%)".

173 http://www.naturalscience.org/wp-content/uploads/2015/01/kompetenzinitiative-ev_study_bees-birds-and-mankind_04-08_english.pdf

174 <http://www.sciencedirect.com/science/article/pii/S0048969715002296>

175 http://www.biolmedonline.com/Articles/Vol4_4_2012/Vol4_4_202-216_BM-8.pdf

176 <https://www.ncbi.nlm.nih.gov/pubmed/23261519>

177 <http://bit.ly/Manvillewildlife>

178 <http://www.ncbi.nlm.nih.gov/pubmed/27650031?dopt=Abstract>

179 <https://onlinelibrary.wiley.com/doi/full/10.1002/bem.22104>

180 <https://nyadagbladet.se/halsa/forhojda-magnetfalt-okar-risken-for-alzheimers-als-och-missfall/>

[Stephen J. Genuis, Christopher T. Lipp – Electromagnetic hypersensitivity: Fact or fiction?](#)¹⁸¹

Overview report on electro-hypersensitivity (EHS). The paper offers a review of the literature on this condition and a discussion of the controversy surrounding the legitimacy of EHS diagnosis. Cites a rich literature considering EHS to be caused and triggered by man made EMFs. Recommendations are provided to assist health professionals.

[Electromagnetic Hypersensitivity – A Summary by Dr Erica Mallery-Blythe](#)¹⁸²

A paediatrician's very comprehensive compilation of available science-based knowledge about EHS (electro-hypersensitivity). Out of the 79 pages, 72 are references to summaries of scientific literature.

[Review study: Li DK et al \(2017\) Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study](#) See also [discussion of the study](#)¹⁸³

This cohort study finds women exposed to high strength magnetic fields during pregnancy, have an increased chance of miscarriage. Today, there are at least 7 published studies that find an increased risk of miscarriage with high exposure to EMF, according to the lead author (see his statements in the review above).

[Review study: Houston et al \(2016\). The effects of radiofrequency electromagnetic radiation on sperm function](#)¹⁸⁴

A large majority of 27 studies find that radiation damages sperm quality, and 4 out of 5 studies find DNA damage as a result of radiation. The review finds evidence that RF radiation from wireless technologies can cause damage to cellular mitochondria, which in turn can lead to oxidative stress and DNA damage.

[Review study: Carter, B. et al.k \(2016\). Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis](#)¹⁸⁵

Review of 20 studies on screen use and sleep in children and adolescents. The study concludes that use of, or access to, screen technology just before bedtime is associated with significant increases in poor sleep quality, less sleep and other sleep problems.

[Adlkofer, F & al. \(2004\). Risk Evaluation of Potential Environmental Hazards From Low Frequency Electromagnetic Field Exposure Using Sensitive in vitro Methods. \(REFLEX-study final report\)](#)¹⁸⁶

This extensive EU-funded study from 2004 found a significantly increased degree of severe DNA damage in several types of cells exposed to pulsed radiation, both low-frequency and high-frequency EMF emissions, at levels below ICNIRP recommendations. See a short summary of the conclusions from the study in: BEMS – Final Summary of REFLEX Offered.¹⁸⁷ The telecommunications industry spent a lot of resources trying to prevent the study from being published and tried to cast doubt on the results by accusing some of the scientists involved of

181 <https://www.elettrosensibili.it/wp-content/uploads/2015/08/genuis-and-lipp-2011.pdf>

182 <http://www.iemfa.org/wp-content/pdf/Mallery-Blythe-v1-EESC.pdf>

183 <http://microwavenews.com/news-center/de-kun-li-miscarriages>

184 <https://www.ncbi.nlm.nih.gov/pubmed/27601711>

185 Description in Swedish: <http://www.stralskyddsstiftelsen.se/2016/12/mobiler-och-surfplattor-forsamrar-barns-och-ungdomars-somn-starkt-och-entydigt-samband-i-forskningen/>

186 https://www.spini.ch/spini/Elektrobiologie/GutachtenStudien/EU-Reflex-Studie_zur_Untersuchung_gentoxischer_Sch_den_2004.pdf

187 <https://www.bems.org/node/592> [Link no longer available.]

misconduct. However, the study and the scientists involved were cleared of all charges by two ethics committees.¹⁸⁸

[EMF Safety: Bibliography of studies showing damage to the blood-brain barrier](#)¹⁸⁹

Bibliography (last updated in 2012) with references to 47 published studies (from 1977-2012) which show that weak radiation from wireless technologies and electromagnetic fields can cause leakage in the blood-brain barrier which, among other things, has the function of protecting the brain from toxins.

Several subsequent studies from recent years confirm these findings. Leakage in the blood-brain barrier is associated with an increased risk, among other things, of neurodegenerative disorders.

4.2.5 What is it about radiation exposure that harms?

It is a characteristic of the biological effects of electromagnetic fields that *the relationships between causes and symptoms is very complex. This is true even if we disregard the complexity associated with cocktail effects and threshold values* (discussed in Chapter 2). Not the least is this complexity due to the fact that living organisms consist of many partly independent, partly dependent systems that try to counteract external influences, and because electromagnetic fields have so many different properties that can affect biology. Probably, only very small parts of these systems have been analysed and understood:

- Living beings contain a wide range of electrochemical processes and communication systems both along nerve pathways and apart from them. The various parts use different frequencies and are sensitive to a number of different aspects of EMF. Mapping is therefore difficult, both in theory as well as in practice.
- Organisms are dynamic: They try to counteract the influences of the external environment, called to uphold *homeostasis*, and they are, to different degrees, resistant to the influences.
- It may take a long time, perhaps many years, before an impact has a consequence in terms of morbidity – or the reaction may occur very soon. It may also take a long time for the reaction to subside. E.g., the lead time for demonstrating statistically significant effects on the incidence of brain tumours from mobile phone use is assumed to be several years. This makes it difficult both to interpret causal relationships and to conduct multiple repeated independent studies to confirm or refute hypotheses.

It is reasonable to assume that such circumstances lead to under-diagnosis in the health care system, expressed in patients' own accounts as "the doctor found nothing". It is also to be expected that the EHS sufferers themselves will take a long time to discover that there was a clear environmental cause for their own health problems, and then to have the suspicion of their sensitivity to EMFs confirmed by shielding themselves from relevant sources.¹⁹⁰ Nor should anyone be surprised that a significant market arises for more or less mysterious products and therapies without any credible explanation as to how they might work, or with no or very poor evidence to justify that they actually do.

In addition, electromagnetic fields have a number of different biologically relevant properties that can vary independently of each other.

188 Description with links to the reports: <https://www.jrseco.com/eu-reflex-study-shows-dna-damage-caused-by-radiation-from-wireless-devices-and-mobile-phones/?c=7315df25d274>

189 <https://www.scribd.com/document/94488334/Electrosmog-and-the-Blood-Brain-Barrier-47-Refs>

190 See e.g. Smart-meter stories, <http://einarflydal.com>, or other anecdotal material.

Physical factors of microwave radiation that are of importance for biological effects – even when the exposures (radiated effect or power level) are far below the limits, are summed up as follows by Firstenberg¹⁹¹, with the references included below the quotation:

"It's not the power level that does the harm. It is the degree of coherence, type and depth of modulation, wavelength, number of frequencies, number of signals, bandwidth, shape of the waves, pulse height, pulse width, rise and fall time, and other properties of the radiation. The unimportance of power levels for effects other than heat effects has been shown many times. In Salford's studies⁽¹⁾ the lowest power levels caused the most leakage in the blood-brain barrier. Blackman,⁽²⁾ Bawin,⁽³⁾ Dutta,⁽⁴⁾ Schwartz,⁽⁵⁾ and Kunjilwar,⁽⁶⁾ found — all in different laboratories — that calcium efflux from neural and cardiac cells [important neurotransmitter, EF] occurred at specific frequencies and exposure levels and did not increase with power. In Dutta's study a 3,000-fold decrease in power caused a 4-fold increase in calcium efflux. Sadchikova^(7,8) and her Soviet colleagues found that workers exposed to the lowest power levels suffered more often from radio wave sickness. Belyaev⁽⁹⁾ found that genetic effects occurred at specific frequencies and the magnitude of the effect did not change with power level over 16 orders of magnitude [that is, 10,000,000,000,000,000 times as strong]."

1. Persson, B. R. R., Salford, L. G., Brun, A. (1997). Blood-brain barrier permeability in rats exposed to electromagnetic fields used in wireless communications. *Wireless Networks* 3:455-461.
2. Blackman, C. F. et al. (1980). Induction of calcium-ion efflux from brain tissue by radiofrequency radiation. *Bioelectromagnetics* 1:35-43.
3. Bawin, S. M., Kaczmarek, L. K. and Adey, W. R. (1970). Effects of modulated VHF fields on the central nervous system. *Annals of the New York Academy of Sciences* 247:74-80.
4. Dutta, S. et al. (1986). Microwave radiation-induced calcium ion flux from human neuroblastoma cells: dependence on depth of amplitude modulation and exposure time. In *Biological Effects of Electropollution*, S. Dutta and R. Millis, eds. Information Ventures, Phila., pp. 63-69.
5. Schwartz, J.-L. et al. (1990). Exposure of frog hearts to CW or amplitude modulated VHF fields: selective efflux of calcium ions at 16 Hz. *Bioelectromagnetics* 11: 349-358.
6. Kunjilwar, K. K. and Behari, J. (1993). Effect of amplitude-modulated RF radiation on cholinergic system of developing rats. *Brain Research* 601:321-324.
7. Sadchikova, M. N. (1960). State of the nervous system under the influence of UHF. In *Biological Action of Ultrahigh Frequencies*, A. A. Letavet and Z. V. Gordon, eds., Academy of Medical Sciences, Moscow, pp. 25-29.
8. Sadchikova, M. N. (1973). Clinical manifestations of reactions to microwave irradiation in various occupational groups. In *Biologic Effects and Health Hazards of Microwave Radiation: Proceedings of an International Symposium, Warsaw, 15-18 Oct., 1973*, P. Czerski et al., eds., Polish Medical Publishers, Warsaw, pp. 261-267.
9. Belyaev, I. Y. et al. (1996). Resonance effect of millimeter waves in the power range from 10(-19) to 3 × 10(-3) W/cm² on Escherichia coli cells at different concentrations. *Bioelectromagnetics* 17: 312-321."

191 Firstenberg, Arthur: NTP analysis – Part II: design flaws and conclusions, unpublished note, 20.04.2018, <https://bit.ly/3MYYYWLH>, or full link: <https://einarflydal.com/wp-content/uploads/2023/05/AFirstenberg-20180412-NTP-analysis-PartIII.pdf>.

As can be seen from the titles of the references, we are not only talking about different properties of electromagnetic fields, but also about a number of other pathways of action other than heating, and affecting fundamental biological processes, such as alteration in *membrane permeability*, *elevated production of oxidants due to increased calcium supply through cell membranes*, and *altered signalling in the nervous system and resonance*.

The findings referred to by Firstenberg imply – provided any single of them is valid – that there is conclusive evidence against the basis of today's limits. This evidence conforms with Karl Popper's strictest type: The justification given for the current exposure limits, is demonstrably wrong.

Also, we may assume that the biological pathways mentioned above apply to all other creatures and life forms as well. Indeed, they have also been detected in a wide range of animals, insects and plants. Sources on the topic include the various reviews referred to in this chapter.¹⁹²

Firstenberg also refers to the finding that even very weak exposure can cause far greater harm than a stronger exposure. Thus, there is not always a *dose-response relationship* between the strength of the exposure and the strength of the reaction, as often taken for granted in toxicology.

This is illustrated in Figure 23¹⁹³, where both a straight, linear relationship is drawn and a "two-phase relationship" with one "window", within which the dose gives virtually no response whatsoever.

The fact that barely measurable doses may have significant effects, *even in dead organic matter*, is demonstrated in the next section about weather sickness and pulses.

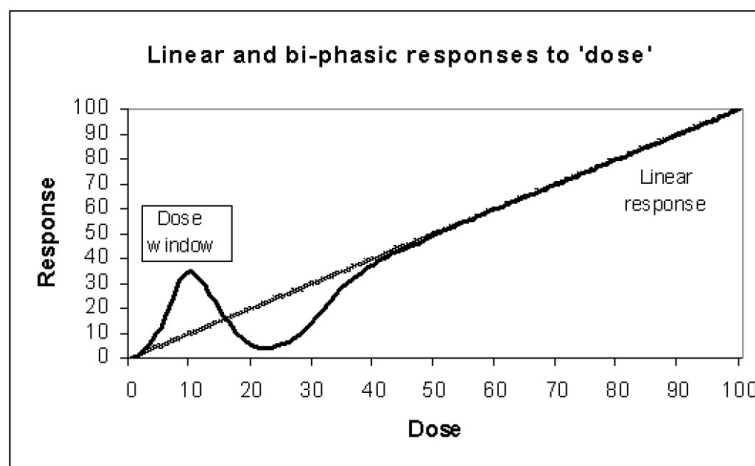


Figure 23: A linear and a non-linear relationship between dose and response (Philips & Philips 2007)

4.2.6 Weather sickness and pulses

In the vast and complex picture of the causes behind biological reactions by electromagnetic fields, one explanation stands out in particular. It does so because it is so simple – and at the same time so unfamiliar and alien, and because it has so much *explanatory power*: It makes understanding so much easier.

192 For a broad overview, see England, S.J. and Robert, D. (2022), The ecology of electricity and electroreception. Biol Rev, 97: 383-413. <https://doi.org/10.1111/brv.12804>

193 Figure taken from Philips, Alasdair and Jean: Are we measuring the right things? (Windows, viewpoints and sensitivity), undated note, Powerwatch.org, <https://www.powerwatch.org.uk/library/getfile.asp?articleID=19&sourceID=1>

This explanation is related to weather sickness, a phenomenon that rheumatism sufferers in particular are familiar to – as many of them get joint pain from changes in weather. Therefore, it was no wonder that professor of rheumatology Erik Kåss (died 1997) was interested in effects from weather. In Gyldendal's Great Medical Encyclopedia he wrote under *Weather Sickness*:¹⁹⁴

“Weather Sickness, a popular term for the fact that some people react to changes in weather with various symptoms, including stiffness and pain in muscles and joints, difficulty concentrating, forgetfulness, fatigue, depression and anxiety. It affects women more often than men. A particular variant is the tendency of rheumatics and migraine sufferers to experience pain before weather changes. There is no explanation for this phenomenon, except that it might be due to the body's sensitivity to electrical changes in the atmosphere.”

After centuries of observations of this phenomenon, weather sickness received its scientific explanation in the latter half of the twentieth century.

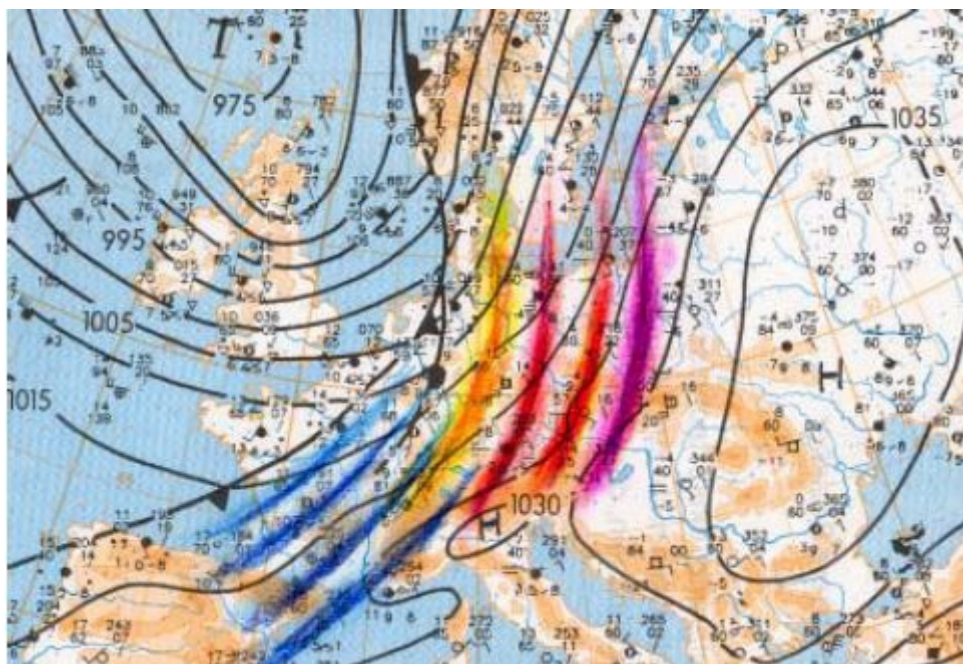


Figure 24: Pulse waves from weather fronts in the North Sea – illustration (Baumer & Sønning 2007)

Two of the key scientists behind the discoveries made in this field were Hans Baumer and Walter Sønning:

Baumer was a laboratory manager in a renowned German printing house for art reproductions, where – as in art printing elsewhere in Europe – the industrial product *chromium-gelatin* (also called *dichromate gelatin* or *DCG*) was used as a coating on the printing plates before illumination and etching. It is made from cow skin and eyes. However, the entire industry had problems with uneven etching and eventually found that it was – of all things – related to the *weather forecast*. Before certain types of weather, the etching of the printing plates became too shallow or too deep. In fact, this problem had been known for a long time in the printing industry. Therefore, engraving professionals usually would correct printing plates after etching. With modern and costly printing

194 Great Medical Encyclopedia, <https://sml.snl.no/værsyke>

machines, downtime for such corrections were not feasible any more. Baumer took charge of a project assigned to find a solution, and got Sönning on board.

Walter Sönning was a medical meteorologist and knew from statistical surveys that more than 50% of the German population had medical histories which were impacted by the *weather forecast, i.e. before the weather changed*. This could apply to all sorts of symptoms — from nosebleeds to depression and joint pain or heart cramps.

So both the chromium gelatin and people reacted to the weather – well before it changed. Hence, extremely low-frequency electrical discharges in the atmosphere were suspected to be cause of the problem. This was not a startling thought to the professionals: Many had been working on such discharges for decades since they interfered with radio communications, and such discharges had long since been known to be generated by weather fronts. It was intriguing that such discharges could affect health. Scientists in many parts of the world were working on this. If so, they might affect the organic material used for the etching process, chromium-gelatin.

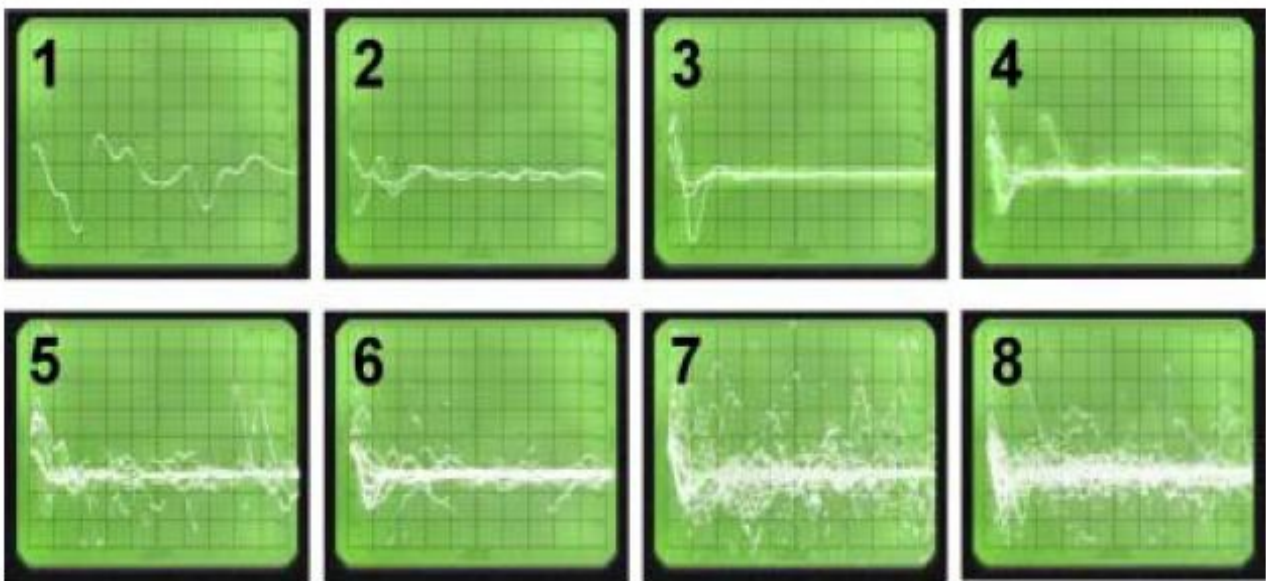


Figure 25: Series of Pulses – "Convective Discharge (or CD) Sferics a.B."
(Sönning 2002)

Baumer, Sönning and their other team members developed antennas and mapped electrical discharges, linking them to different meteorological situations involving moving air masses in the weather fronts. They found systematic correlations between air currents and the frequencies of discharges. Particular weather changes would result in specific discharges that deviated sharply from the normal daily variation of discharges – and then people became ill (Figure 26).

Together with other researchers in the field, Baumer and Sönning published a number of articles, but their major work was not finished until 2002 and was never printed.¹⁹⁵ By then, Sönning's subject, medical meteorology, had vanished; the printing industry had changed technology and got rid of chromium gelatin, Baumer was dead and research funds for this field had dried up all around the world.

195 Hans Baumer and Walter Sönning: The natural impulse frequency spectrum of the atmosphere (CD-Sferics a.B.) and its biological effectiveness, 2002 (47 pages, German, unpublished, on permission from Sönning (2018) downloadable at <https://einarflydal.com/wp-content/uploads/2017/03/baumersc3b6nning-das-natc3bcrliche-impuls-frequenzspektrum-der-athmosphc3a4re2002.pdf>

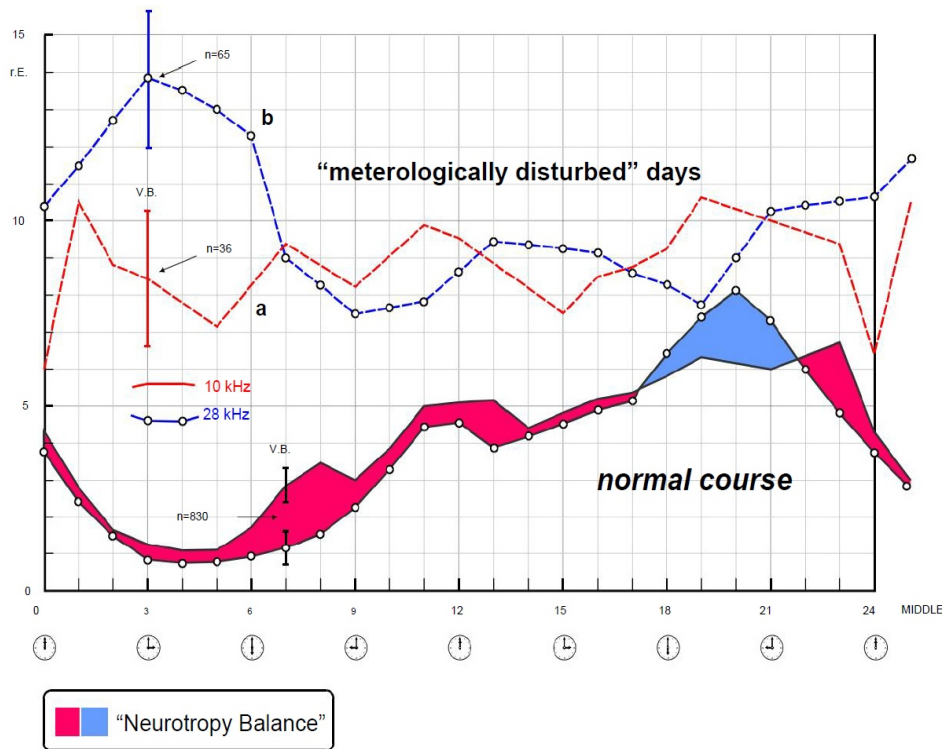


Figure 26: 24 hour Pattern for 10 kHz and 28 kHz pulses from weather fronts
Normal variation (bottom) and on days with strong deviations (top)
(Baumer & Sönning, 2002)

But in Germany, a new health problem had become prevalent: "*die Mobilkrankheiten*" – health problems from mobile communications. The two showed astonishing similarities, and Baumer and Sönning had already understood why:

In 2005, Sönning authored the following small summary (with Baumer posthumously). It is reproduced here in its entirety with Walter Sönning's permission¹⁹⁶:

The biological impact of natural and technical low-frequency electric fields:
Weather sensitivity and "mobile radiation sensitivity".
(Summary)

1. In demographic surveys conducted in Germany, more than half of those interviewed said they were *weather sensitive*. According to scientific studies, *weather sensitivity* manifests itself individually with very different symptoms and degrees of severity without being an independent disease. The sensitivity to the weather only indicates pre-existing health weaknesses or worsens the symptoms of other diseases or disorders that the person already suffers.

2. An important causal factor behind *weather sensitivity* is natural impulse radiation from the atmosphere (AIS). The single pulses of this radiation (= CD-Sferics) may form [as envelope curves, E.F] frequencies between about 2 kHz and 60 kHz, resulting in continuous and fixed frequencies of longer duration, around 10 kHz and 28 kHz in the total spectrum of the atmosphere.

196 On the biological effectiveness of natural and technical low-frequency E-fields: weather sensitivity and "mobile phone sensitivity". (Summary) May 2005, note in German (translated by Einar Flydal)

3. These CD-Sferics (= Convective Discharge Sferics) occur in *the weather layers* of the atmosphere through the movements of various kinds of air masses in our daily weather. They are created from elementary invisible field discharges and should not be confused at all with the electromagnetic signals from visible lightning!

4. As early as 1980, it was demonstrated how a series of impulses forming a frequency greater than 1 Hz *affected the permeability* of thin photographic dichromate-treated *gelatin membrane films* used for etching the copper plate of the printing cylinder used for the rotary gravure printing process in printing industry. This also confirmed, as a model, the existence of a biochemical effect *that was not based on heating*. The disturbing impact consisted in a weather-dependent increase or decrease in the rate of acid penetration through the gelatin membrane [made from cow hides and eyes, with collagen as main constituent].

5. This low-frequency based causation model explains that the weather-dependent CD-Sferics radiation also changes the pore size in the dichromate gelatin through a *resonant coupling* to the polyproline helices in the collagen-protein molecules. A precondition for that to happen, is that each single pulse must have *resonant able shape* (i.e., sinusoidal) and that they are of a suitable width and come as with frequency “tails” of the right refraction timing, and so happens in suitable weather conditions.

6. This biochemical model of how AIS affects biology made it possible to understand the many and often seemingly contradictory, single symptoms that characterise *weather sensitivity*, and to do so in a nuanced and meaningful way. In some cases (e.g. epilepsy), it brought a causal explanation.

7. Based on the fact that the frequency pattern in wireless communication technology (UMTS, EDGE, WiMax, etc.) is increasingly approaching the natural patterns of CD-Sferics, and increasing in volume in an uncontrolled manner, it follows by necessity from the above that these forms of communication will lead to *non-thermal* (ultra-weak) cellular biological effects!

Precautionary policy measures are therefore required as quickly as possible. There are already clear evidence from medical practice that pulsed radiofrequency fields from communication technologies have become a general and significant public health problem. This calls for action!

Dipl. Met. Walter Sönning & Hans Baumer (p.m.) May 2005

So, the same characteristic pulses that Sönning and Baumer and other researchers found in the weather systems were also found in microwave communication.

This allowed them to explain biological reactions to mobile telephony in the same way that they and other scientists could explain weather sickness and the uneven etchings – as a result of *extremely weak electrical pulses at certain frequencies affecting how the permeability of collagen molecules is impacted*.

Collagen is found in membranes throughout the body, and in cow eyes and hides from which chromium gelatin is made. How easily various substances seep through these membranes, affects not only metabolism, but also the energy exchange between glial cells and nerve cells in the brain, and thus nerve signalling.

The frequencies that occur most often in the weather systems — 4, 6, 8, 10, 12, and 28 kHz — are seen as peaks in Figure 27. The frequency of 28 kHz opens the collagen molecule, the others restrict it. Sönning informed the author of this book by email that these frequencies affecting the density of collagen molecules were already known by the Max Plank Institute – but not the connection to weather sickness.

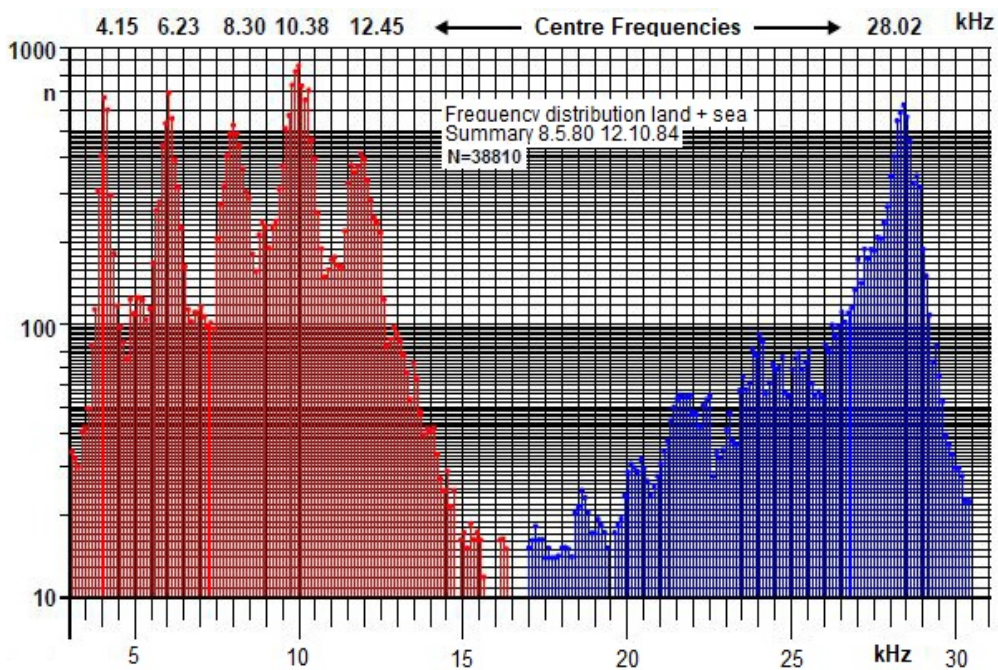


Figure 27: The most frequent discharges in weather systems control collagen density (Baumer & Sönning 2002)

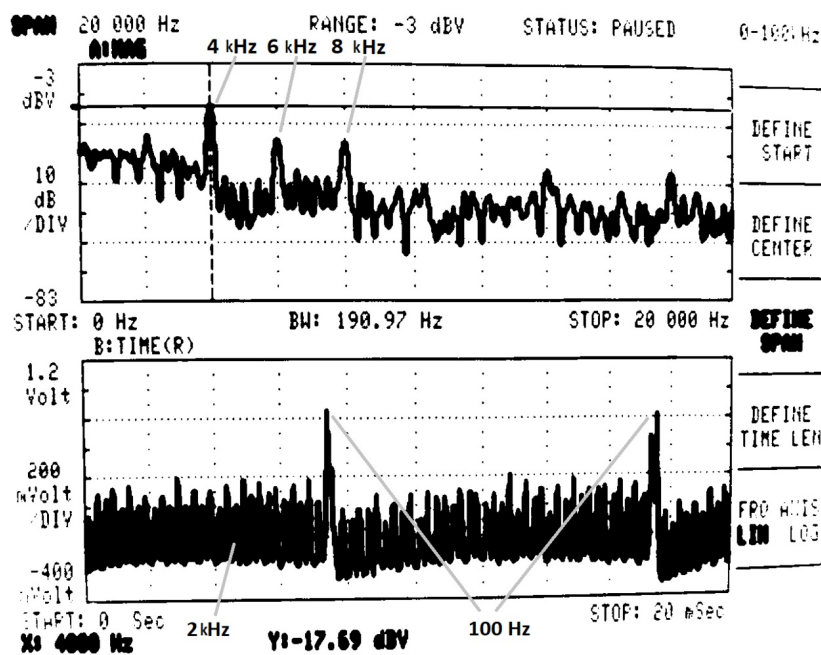


Figure 28: 4G mobile signals show frequencies affecting collagen (Marcel Honsbeek)

These same frequencies affecting collagen permeability are found in microwave communication. This can be easily detected by Fourier analysis: They appear as more or less random features. Figure 28 shows 4, 6 and 8 kHz frequencies as part of the microwaves from a random 4G mobile telephony phone log. Any analysis of signalling from AMS/smart meter transmissions would also show such frequencies as well as others that may also be bio-active in some way.

As discussed in Chapter 2, radio signals weaken down to a quarter each time the distance from the antenna to the measuring point is doubled. But as explained, this was what was assumed to be the case in the old days, before the sharp, strong pulses of radar and microwave communications became commonplace. Now one must expect the pulses, from microwave transmitters like those we have in AMS/smart meters and in the 5G systems that are now being rolled out, to have an impact over much further distances.

Actually, it's been like this all along. The engineers just didn't know it: The pulses from weather systems can act over unimaginably large distances. During Baumer and Sönning's studies, the two were able to demonstrate that pulses of the type they were studying, CD-Sferics, could occur in weather fronts in the North Sea and affect the permeability of chromium-gelatin in acid baths in steel tanks in concrete buildings in Munich – some 800 kilometres away.

It didn't seem possible, but it was verified time and time again. For the scientists themselves, it remained only partially understandable. It had to be explained by *resonance*, which requires almost no energy, and by what Baumer and Sönning ended up naming the *informational value* of the pulse, to express that pulses have effects even with almost no physical energy.¹⁹⁷

There may, of course, be other biological entities that resonate or are disturbed at other pulse rates. The possibilities for such impacts are almost endless and beyond investigation.

Microwave communication is regulated by the Norwegian Radiation Protection Authority in accordance with ICNIRP guidelines based on the amount of energy transmitted. Baumer and Sönning and other researchers found significant biological effects coming from the low-frequency discharges in the atmosphere, affecting people's health without any significant amount of energy. ICNIRP's guidelines are blind to such effects, and therefore so are the Norwegian limits and measurement methods.

This field of research "dried up" due to lack of research funding in the 1980s, at a time when it had become quite clear that future exploitation of microwave-based communication would consist precisely in creating pulses that would necessarily have biological effects.

By this time, there was a growing willingness to claim that such reactions as Sönning and Baumer and a number of other scientists found from the weather systems, simply could not be possible:

Firstenberg describes how a Swiss scientist, Hans Richner, a professor of physics at the Swiss Federal Institute of Technology, stood on the podium at the 19th International Conference and of Biometeorology, held in September 2008 in Tokyo, and argued that research on health effects from the pulses in the air should now be discontinued, since the fact that people now use mobile phones shows that these pulses cannot do any harm!¹⁹⁸ Hence, Richner relied on the thermal dogma of energy intensity, claiming that as the electromagnetic fields used for commercial cell phone communications were safe and so much stronger than those occurring naturally in the atmosphere, decades of research findings were wrong and biometeorologists should not study the impact on humans from electric fields any more!

197 Personal communication from Walter Sönning to E. Flydal, email. Information value is a purely relational quantity.

198 Firstenberg 2017, op.cit., see note 52. Chapter 3, Weather Sensitivity

One reason for this turnaround may be the fact that if one were to take into account the knowledge of how all life is governed by these and other weak discharges in nature, the technological and commercial exploitation of microwave communication would not be allowed.

Hans Baumer, Walter Sönning and a number of other German scientists with a solid background in medicine and physics got involved in awareness raising activities. Some joined the association with the long name "Kompetenzinitiative zum Schutz von Mensch, Umwelt und Demokratie e.V." [Competence Initiative for the Protection of People, Environment and Democracy]¹⁹⁹ and chose the slogan "Health is not a commodity".

The organisation is led by a panel of scientists with extensive expertise in medicine, radiation physics and biology. Its main activity is to warn against the threat to health and the environment through lectures and popular science publications, and to appeal to the authorities as in the *Freiburg appeal*, which follows.

Their booklets are exceptional; thorough and academically sound. Some of them have been translated into English.²⁰⁰ Here we not only see German thoroughness and quality at its best, and content founded on a long history of research on radiation and biological effects, but also the courage to speak out against the authorities and to put the lack of radiation protection into a political context – as a threat not only to life, but to our form of society. They do so with the confidence that follows their abundance of heavyweight doctor's degrees and long academic careers:

“The claim that the German exposure limits protect us from the effects of electromagnetic radiation is one of the biggest and most dangerous lies of our time.”²⁰¹

199 <http://kompetenzinitiative.com/>

200 <https://kompetenzinitiative.com/english-brochures/>

201 Richter, Karl: Kommerz, Health and Democratic Culture, St. Ingbert 2005

*Freiburg Appeal 2002*²⁰²

Out of great concern for the health of our fellow human beings do we – as established physicians of all fields, especially that of environmental medicine – turn to the medical establishment and those in public health and political domains, as well as to the public.

We have observed, in recent years, a dramatic rise in severe and chronic diseases among our patients, especially:

- Learning, concentration, and behavioural disorders (e.g. attention deficit disorder, ADD)
- Extreme fluctuations in blood pressure, ever harder to influence with medications
- Heart rhythm disorders
- Heart attacks and strokes among an increasingly younger population
- Brain-degenerative diseases (e.g. Alzheimer's) and epilepsy
- Cancerous afflictions: leukaemia, brain tumours.

Moreover, we have observed an ever-increasing occurrence of various disorders, often misdiagnosed in patients as psychosomatic:

- Headaches, migraines
- Chronic exhaustion
- Inner agitation
- Sleeplessness, daytime sleepiness
- Tinnitus
- Susceptibility to infection
- Nervous and connective tissue pains, for which the usual causes do not explain even the most conspicuous symptoms

Since the living environment and lifestyles of our patients are familiar to us, we can see – especially after carefully-directed inquiry – a clear temporal and spatial correlation between the appearance of disease and exposure to pulsed high-frequency microwave radiation (HFMR), such as:

- Installation of a mobile telephone sending station in the near vicinity
- Intensive mobile telephone use
- Installation of a digital cordless (DECT) telephone at home or in the neighbourhood

We can no longer believe this to be purely coincidence, for:

- Too often do we observe a marked concentration of particular illnesses in correspondingly HFMR-polluted areas or apartments;
- Too often does a long-term disease or affliction improve or disappear in a relatively short time after reduction or elimination of HFMR pollution in the patient's environment;
- Too often are our observations confirmed by on-site measurements of HFMR of unusual intensity.

On the basis of our daily experiences, we hold the current mobile communications technology (introduced in 1992 and since then globally extensive) and cordless digital telephones (DECT standard) to be among the fundamental triggers for this fatal development. One can no longer

202 This appeal eventually received the signature of around 1,000 practising doctors and the support of 36,000 others. The original text can be found here <http://www.cellphonetaskforce.org/wp-content/uploads/2018/11/Freiburger-Appeal-original-English.pdf>

evade these pulsed microwaves. They heighten the risk of already-present chemical/physical influences, stress the body's immune system, and can bring the body's still-functioning regulatory mechanisms to a halt. Pregnant women, children, adolescents, elderly and sick people are especially at risk.

Our therapeutic efforts to restore health are becoming increasingly less effective: the unimpeded and continuous penetration of radiation into living and working areas – particularly bedrooms, an essential place for relaxation, regeneration and healing – causes uninterrupted stress and prevents the patient's thorough recovery.

In the face of this disquieting development, we feel obliged to inform the public of our observations – especially since hearing that the German courts regard any danger from mobile telephone radiation as “purely hypothetical” (see the decisions of the constitutional court in Karlsruhe and the administrative court in Mannheim, Spring 2002).

What we experience in the daily reality of our medical practice is anything but hypothetical! We see the rising number of chronically sick patients also as the result of an irresponsible “safety limits” policy, which fails to take the protection of the public from the short- and long-term effects of mobile telephone radiation as its criterion for action. Instead, it submits to the dictates of a technology already long recognized as dangerous. For us, this is the beginning of a very serious development through which the health of many people is being threatened.

We will no longer be made to wait upon further unreal research results – which in our experience are often influenced by the communications industry – while evidential studies go on being ignored. We find it to be of urgent necessity that we act now!

Above all, we are, as doctors, the advocates for our patients. In the interest of all those concerned, whose basic right to life and freedom from bodily harm is currently being put at stake, we appeal to those in the spheres of politics and public health. Please support the following demands with your influence:

- New health-friendly communications techniques, given independent risk assessments before their introduction

and, as immediate measures and transitional steps:

- Stricter safety limits and major reduction of sender output and HFMR pollution on a justifiable scale, especially in areas of sleep and convalescence.
- A say on the part of local citizens and communities regarding the placing of antennae (which in a democracy should be taken for granted).
- Education of the public, especially of mobile telephone users, regarding the health risks of electromagnetic fields.
- Ban on mobile telephone use by small children, and restrictions on use by adolescents
- Ban on mobile telephone use and digital cordless (DECT) telephones in preschools, schools, hospitals, nursing homes, events halls, public buildings and vehicles (as with the ban on smoking)
- Mobile telephone and HFMR-free zones (as with auto-free areas).
- Revision of DECT standards for cordless telephones with the goal of reducing radiation intensity and limiting actual use time, as well as avoiding the biologically critical HFMR pulsation
- Industry-independent research, finally with the inclusion of amply available critical research results and our medical observations.

5. More warnings from professionals

Professionals in biology, medicine and radio-radiation all over the globe have warned against the health effects of microwave radiation for a number of years. In particular, they have warned against this technology being increasingly used by more and more people, that low frequency pulsations are getting increasingly stronger and more frequent, and that ever higher frequencies are used.

Higher frequencies have greater data capacity, but also shorter range. This leads to closer distances between antennas and thus stronger impact – even if the measured exposure from each antenna decreases. Because of the way exposure is measured – according to current guidelines by measuring power density on average over several minutes – lower measurement values are obtained even if the biological impact increases from stronger pulses being used. The measurement method is largely irrelevant for such effects.²⁰³

Professionals warn against the limits and measuring methods being out of date, and against the creation of an environment with microwaves everywhere, from which it is difficult, or downright impossible, to shield oneself.

Some professional heavyweights have issued individual warnings – for example; the former military specialists in microwave technologies and military use, the Canadian Jerry Flynn²⁰⁴ and the Briton Barry Trower²⁰⁵.

A number of specialists in medicine, biology and environmental science express the view that modulated (pulsed) microwave technology is on a collision course not only with the most basic requirements for the physical environment for humans to thrive, but also for other living beings. They warn not only of acute effects, but of a generalised, almost imperceptible slight increase in morbidity that will accumulate over time. And they are asking for the immediate introduction of much stricter limits.

Here follows only a small selection of such sources. The first ones specifically deal with AMS/smart meters, but all apply to relevant technology – pulsed, microwave-based radio communication in consumer products and from antennae masts around us.²⁰⁶

Research-based warnings about harmful health effects from AMS/smart meters

[Recommendations Regarding Electromagnetic and Radiofrequency Exposure – The American Academy of Environmental Medicine \(AAEM\)](#)²⁰⁷

Recommends doctors to take seriously patients with health problems related to EMF/radiation and that these patients must be allowed to have AMS/smart meters removed from their homes.

[Electromagnetic and Radiofrequency Fields Effect on Human Health – American Academy of Environmental Medicine \(AAEM\)](#)²⁰⁸

Statement on health effects in general and on smart meters/AMS.

203 An example from the Norwegian National Radiation Protection Authority shows how misleading such measurements may be, is given (in Norwegian) in Flydal, Einar: [Smart meters: The Radiation Protection Authority bites its teeth](#), blog post 27/06/2018

204 Flydal, Einar: - [It's because of the damage it creates, that we use microwaves as weapons!](#), blog post 23/05/2016

205 Search YouTube for a wide variety of interviews. Trower also goes to great lengths to claim that modern microwave communication systems are designed with the intention of being able to cause harm to the population. However, his expertise and view of biological effects are not dependent on his view as to such an intention.

206 The selection is taken from Kåss & Halmøy 2018. op. cit., see note 152

207 <https://www.aemonline.org/wp-content/uploads/2020/12/AAEMEMFmedicalconditions.pdf> (Updated 31.1.2023)

208 <https://www.aemonline.org/wp-content/uploads/2020/12/emfpositionstatement.pdf> (Updated 31.1.2023)

[Letter from a scientist against 5G and AMS/smart meters – Beatrice Alexandra Golomb, MD, PhD](#)²⁰⁹

Professor of medicine and radiation researcher warns in a letter against the development of 5G (which is facilitated in the USA through the bill SB 649) and AMS/smart meters.

Research-based warnings about harmful health effects from 5G and other microwave radiation

[Letter from a scientist against 5G – Prof. Em. Martin Pall, PhD](#)²¹⁰

Letter to the legislative authorities of California from Prof. Martin Pall regarding expected adverse effects from the development of a 5G network in California, with Appendix²¹¹:
References to 142 important overview studies finding non-thermal adverse effects.

[Letter to the FCC from MD Yael Stein in Opposition to 5G Spectrum Frontiers](#)²¹²

"Please protect Public Health and vote against exposure of the public to harmful 5G technology."

[International medical doctors and researchers appeal for a moratorium on 5G, 2017](#)^{213, 214}

2017: Major international appeal to the EU Parliament demanding a halt in 5G development until the health risks have been clarified. The researchers and doctors behind the appeal believe there is reason to suspect risks of serious adverse effects over time.

Research-based warnings about harmful health effects from microwave radiation in general

[EMF-scientists: Major researcher appeal to WHO and UN](#)²¹⁵ – the [actual appeal text with signatures](#),^{216, 217}

As of today (April 2018), 237 international researchers in the EMF field from 41 nations have signed an appeal to the WHO and the UN in which they demand immediate measures – particularly with regard to children and pregnant women – and far stricter limits. All those who have signed are professionals having published peer-reviewed research within this field. The appeal emphasises that harmful effects apply to all biological life.

[The American Academy of Environmental Medicine \(AAEM\) - On the need for limits that take into account proven non-thermal harmful effects](#)²¹⁸

Mentions a number of harmful health effects that have been demonstrated at non-thermal (non-heat-generating) levels far below current limits, refers to electro-hypersensitivity as a disability, and calls for new and better limits and guidelines.

209 <https://ehtrust.org/wp-content/uploads/Golomb-SB-649-5G-letter-2017-08-18b.pdf>

210 <http://electromagnetichealth.org/wp-content/uploads/2017/08/Pall-Letter-to-CalLegis-FINAL-8-7-17.pdf>

211 <http://electromagnetichealth.org/wp-content/uploads/2017/10/142-Reviews-Pall-PhD.pdf>

212 <https://ehtrust.org/letter-fcc-dr-yael-stein-md-opposition-5g-spectrum-frontiers/>

213 http://www.stralskyddsstiftelsen.se/wp-content/uploads/2017/09/scientist_5g_appeal_final.pdf

214 https://einarflydal.files.wordpress.com/2017/09/5g-appell_2017_norsk.pdf (Norwegian)

215 <https://emfscientist.org/>

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

217 https://emfscientist.org/images/docs/transl/Norwegian_EMF_Scientist_appeal_2017.pdf

218 https://einarflydal.com/wp-content/uploads/2023/05/2013-Scientific_and_Medical_Outcry_and_Appeal.pdf

See also AAEM Position Paper: <https://www.aaemonline.org/electromagnetic-and-radiofrequency-fields-effect-on-human-health/>

[The Russian Radiation Protection Agency criticises the WHO's EMF Project for misrepresenting the views of the scientific community, 2017](#)²¹⁹

In March 2017, the NCNIRP (the Russian National Commission for Non-Ionizing Radiation Protection) wrote a letter to the World Health Organization (WHO) in which the WHO's EMF Project "RF working group" is criticised for being unilaterally composed, for having problematic ties to ICNIRP, and for not representing the positions of the majority of researchers in the field when it comes to the harmful effects of non-thermal RF radiation. WHO is requested to provide a more balanced and capable EMF Working Group.²²⁰

The letter also clearly states that the Russian Radiation Protection Agency considers ICNIRP's current limits [i.e. those of 1998] to be irrelevant for protecting against non-thermal damage. It is also emphasised that the Russian Radiation Protection Agency has consistently and for a long time warned against the potential harmful health effects of mobile phone radiation, and informed that these warnings are based on findings in a number of Russian and international studies and that also several hundred more recent studies support this view.

5.1 Warnings from supranational / international bodies

There have been a number of reports of concern from international bodies stating that thermally based guidelines are not sufficient to provide reasonable radiation protection. Here are just a few:²²¹

- WHO's ELF [extremely low frequency] Health Criteria Monograph 2007
- SCENIHR Report 2006 prepared for the European Commission
- UK SAGE Report, 2007
- statement from the Health Protection Agency, United Kingdom, 2005
- statement from the NATO Advanced Research Workshop, 2005
- statement from the US Radiofrequency Inter-agency Working Group, 1999
- US Food and Drug Administration (FDA), 2000 and 2007
- statement from the WHO in 2002
- the cancer classification 2B by the WHO Agency for Research on Cancer (IARC), 2001 and 2011
- the British Parliament's Independent Expert Group's Report on Mobile Phones – the so called Stewart Report, 2000

We see that more WHO agencies are represented. It is thus a truth with modifications when claimed by the Norwegian authorities that Norwegian authorities "follow the WHO" as to exposure limits: Norway follows a small office in the WHO with a divergent view and a strong industry affiliation: "The International EMF Project". (More on this in section 6.1.) The tone is quite different in the WHO's cancer research agency IARC:

219 http://www.emfsa.co.za/wp-content/uploads/2017/03/2017_03_01_WHO.pdf

220 As of May 2018, it appears that there is a possibility that the Russian complaint may have been heard. See Leszczynski, Dariusz: [Emerging possibility for a meticulous, impartial review of the EMF science at the WHO](#), blog post 02.05.2018, <https://betweenrockandhardplace.wordpress.com/>

221 The list is taken from the BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Radiation, www.bioinitiative.org, December 31, 2012

[The International Agency for Research on Cancer, IARC/WHO: cancer classification group 2B \(press release\)](#)²²² [International Agency for Research on Cancer \(IARC\) – List of classifications](#)²²³

In 2011, RF/microwave radiation from wireless radio technology in general was given the cancer classification "Group 2B – possible carcinogen" by the International Agency for Research on Cancer, IARC, which is a WHO body. Previously, low-frequency fields were classified in the same hazard class 2B. Usually such a classification is enough to trigger precautionary measures and labelling with warnings.

Several of the experts who participated in the IARC classification believe it is time to classify this type of radiation as either group 2A: "probably carcinogenic" or group 1: "carcinogenic" (Dr. Anthony B. Miller and oncologist Dr. Lennart Hardell in 2018 and 2017, and Adjunct Prof. Dariusz Leszczynski in 2014), due, among other things, to an increased risk for several types of cancer being confirmed by several comprehensive and methodologically strong studies in recent years.

[European Parliament, Resolution, 2009](#)²²⁴

The European Parliament calls, in the form of a resolution, for strict precautionary practices to avoid the harmful effects of man-made electromagnetic fields and radiation from wireless technology.

[European Parliament, Resolution, 2008](#)²²⁵

The European Parliament's resolution states that the limits (set in 1998, and still in force) are outdated and that there is therefore a need for stricter limits.

[Parliamentary Assembly of the Council of Europe, resolution, 2011 – The potential dangers of electromagnetic fields and their effect on the environment](#)²²⁶

After reviewing the research, the Parliamentary Assembly of the Council of Europe urged its member states to introduce precautionary measures, and to use all reasonable means to reduce radiation exposure, especially with a view to safeguarding the health of children and young people. Among other things, as an immediate measure, the assembly recommends limits indoors that are 10,000 times lower than the current ones – in the long term 100,000 times lower – as well as wired networks and restrictions on mobile phone use in schools.

5.2 Relevant guidelines and limits for biologically based radiation protection

The particularly high exposure limits recommended in ICNIRP's guidelines²²⁷ (see Figure 1) have led several professional communities in the West to put forward proposals for other biologically based guidelines and proposals for limits for exposure to various types of electromagnetic fields.

Their views are more or less identical, but have been sharpened in line with new knowledge. New generations of microwave-based communication systems with "hard" pulsing have also led to new

222 http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

223 <http://monographs.iarc.fr/ENG/Classification/>

224 <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2009-0216+0+DOC+XML+V0//EN>

225 <http://www.europarl.europa.eu/sides/getDoc.do?type=TA&language=EN&reference=P6-TA-2008-0410>

226 <http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=17994&lang=en>

227 ICNIRP 1998, op. cit., see note 5

needs for regulation. Their suggestions are based on research as well as on experiences with radiation for therapeutic treatments.

The most important proposals are mentioned here, in historical order:

- The *Professional Association of German Building Biologists*' standards are based on a combination of theoretical studies and extensive practical experience in improving living environments for people who become ill, or who want a house with a minimum of environmental toxins.

The building biologist movement is interdisciplinary with roots in academic environmental and health interests, founded in the early 1970s. It provides additional training for engineers and has several thousand certified members, primarily in German-speaking areas.

The building biologists' standards cover a number of different environmental toxins. Their recommended maximum levels for exposure to high-frequency electromagnetic fields apply to bedrooms and other rooms where people spend a large amount of time. The standard applies per source. I.e., each transmitter with GSM, UMTS, WiMax, TETRA, DECT, WiFi source, etc., is measured separately and added up.

The building biologists' classification indicates how strong a reason there is to take measures:²²⁸

Recommendation for bedrooms ($\mu\text{W}/\text{m}^2$)			
Negligible	Moderate	Strong	Very Strong
<0.1	0.1 – 10	10 – 1000	>1000

- *The Seletun declaration* is a declaration by seven researchers from five countries, issued after a conference in Stavanger, Norway, in 2009. The declaration attracted international attention. Among other things, the declaration contained these ten points, with more details though:²²⁹
 1. The global population is at risk.
 2. Sensitive populations are currently vulnerable.
 3. Government actions are warranted now, based on evidence of serious disruption to biological systems.
 4. The burden of proof for the safety of radiation-emitting technologies should fall on producers and providers, not consumers.
 5. EMF exposures should be reduced until complete understanding of the mechanisms of action is reached.
 6. The current accepted measure of radiation risk—the Specific Absorption Rate ('SAR')—is inadequate, and misguides on safety and risk.
 7. An international disease registry is needed to track time trends of illnesses to correlate illnesses with exposures.
 8. Pre-market health testing and safety demonstration of all radiation-emitting technologies.
 9. Parity needed for occupational exposure standards as to sex and age.
 10. People with electro-hypersensitivity should be considered functional impaired.

228 BAUBIOLOGIE MAES / Institut für Baubiologie + Nachhaltigkeit IBN: Building biology benchmarks for sleeping areas, supplement to the Standard for Building Biology Measurement Techniques, SBM-2015,

<https://www.baubiologie.de/downloads/richtwerte-schlafbereiche-15.pdf>

229 <https://electromagnetichealth.org/wp-content/uploads/2011/02/Seletun-Transcript.pdf>

The Seletun statement recommended limits as follows (summary):

- For extremely low frequency fields (ELF) limits should be set to between $1/1,000$ and $1/10,000$ of ICNIRP's recommendations.
- For radio frequency fields (and microwaves), a provisional limit – which "in the future may have to be lowered further" – should be set to $170 \mu\text{W}/\text{m}^2$, which is around $1/50,000$ to $1/60,000$ of ICNIRP's recommendations.
- *The BioInitiative report*²³⁰ was published in 2007, with a revision in 2012. Certain additions have been made later and published on the same website. The report was created by a team of 29 prominent professionals in the field and is very comprehensive (7,000 studies are reviewed over 1,557 pages). Each part of the report has since been published as peer-reviewed articles.

The BioInitiative report finds clear evidence of health-damaging effects from "sub-thermal" EMFs in each of the following areas: *cancer* (childhood leukaemia and cancer among adults), *the nervous system* and *brain functions, genes* (DNA), *stress proteins* (HSP), *the immune system*. The report also states that there are therapeutic applications of such electromagnetic fields.

The report emphasises that key damage mechanisms are not linked to heating at all, but are better understood, e.g., as *information value*.²³¹ Such an understanding means ...

"...that an entirely new basis (a biological basis) for new exposure standards is needed. New standards need to take into account what we have learned about the effects of ELF and RF (all non-ionizing electromagnetic radiation and to design new limits based on biologically-demonstrated effects that are important to proper biological function in living organisms. It is vital to do so because the explosion of new sources has created unprecedented levels of artificial electromagnetic fields that now cover all but remote areas of the habitable space on earth. Mid-course corrections are needed in the way we accept, test and deploy new technologies that expose us to ELF and RF in order to avert public health problems of a global nature."

The report also points out that the purely theoretical basis for the current limits has long since been proven to be insufficient. Here the report indicates that there may not be any safe lower limit:

"Until we know if there is a lower limit below which bioeffects and adverse health impacts do not occur, it is unwise from a public health perspective to continue "business-as-usual" deploying new technologies that increase ELF and RF exposures, particularly involuntary exposures."

The BioInitiative report therefore also does not specify any concrete exposure limits.

(The report has been rejected by ICNIRP, among other reasons, on the grounds that it was not published in a peer-reviewed journal until after it was posted online.)

- *EUROPAEM EMF guidelines 2016 for the prevention, diagnosis and treatment of EMF-related health problems and diseases* partly builds on the previous guidelines.

230 BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Radiation, at www.bioinitiative.org, December 31, 2012

231 Note that this corresponds to Baumer & Sönning's explanations of how ultra-weak pulses from weather fronts can have a biological effect. It is connected, among other things, also to quantum theory.

These guidelines were prepared by a large professional team and published by a European organisation for environmental medicine: The European Academy for Environmental Medicine, EUROPAEM. The standard has been peer-reviewed and published as a professional paper.²³²

The document is a *norm*, i.e., a *guideline* and *procedure* offered as a *standard*. It contains a professional summary, a subject-based guide to preventing and treating EMF/radiation-related health problems, technical explanations, *suggestions* for precautionary reference values that take into account the various modulation characteristics of different man made radiation sources, diagnostic and therapeutic tools, as well as a large bibliography.

In line with the commonly used model shown in Figure 11, the EUROPAEM standard considers radiation from wireless technology to be much similar to other environmental toxins (also called *environmental stressors*). It prescribes diagnostic methods and therapeutic measures in accordance with this view.

EUROPAEM does not give specific recommendations as to AMS/smart meters, nor as to their frequencies and their pulsations. Based on EUROPAEM's Table 3 (page 19) and the pulse frequency of the "Norwegian" meters, we estimate that for AMS/smart meters, the EUROPAEM standard will recommend a precautionary maximum level for bedrooms of 10 $\mu\text{W}/\text{m}^2$ to 1 $\mu\text{W}/\text{m}^2$ at night, and $1/10$ of this for the particularly sensitive:

Meter	Frequency (MHz)	Pulsation rate	EUROPAEM 2016 ($\mu\text{W}/\text{m}^2$) At night
Kamstrup	444	15 minutes	10
Nuri	870	> 2 seconds	10
Aidon	870	0.8 seconds	1

Figure 29: Frequencies, pulsation rate and EUROPAEM's recommended maximum values for exposure from AMS/smart meters installed in Norway for the general population

Values as low as shown in the table are not possible to achieve with wireless AMS/smart meters without careful and comprehensive shielding, and then they most probably do not work. It is also stated in the standard, just before Table 3b:

“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 below. Frequencies to be measured should be adapted to each individual case.”

5.3 Does it help by reducing the radiated power?

The experience of most, or perhaps all, electromagnetic (hyper)sensitive people is that the acute health problems are greatly reduced when exposure – measured as power density – is reduced. Experience shows this to be so.²³³ However, energy intensity is just one parameter, and not necessarily the most important one. It may even be irrelevant:

232 Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshhammer, 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](#): DOI 10.1515/reveh-2016-0011

233 For anecdotal evidence, there is an abundance of sources. For a collection of smart meter stories (Norwegian), see <https://einarflydal.com/smartmalere-sykdomshistorier/>. See also EUROPAEM 2016 op. cit., see note 33, on effects of various therapies.

The modulation produced by AMS/smart meters, i.e. the way such meters convey information by modifying their very weak carrier wave, consists of very steep, strong and short pulses. We are talking sudden intensities hundreds of times stronger than the carrier wave and durations measured in milliseconds. Such pulses are so short that the measuring devices may not pick up more than a sample of them:

The measuring devices do not log continuously, but sample at certain intervals. As pulses from the meters are so short – a few milliseconds – and sharp, many of them might fall between the samples, even if you log for a long time.

Anyhow, the pulses from the meters will have relatively little significance for the measurement result:

The measurement method was designed to measure *power density*. This is important if you're looking for the *heating effect over a certain time span*. But these short pulses with such long pauses in between have no such effect. So, measured power density may therefore decrease as new modulation techniques are developed, even while the pulses become stronger and/or more frequent and more abrupt and gain greater biological impact, as cited from Sønning & Baumer further below.

When it is argued from the Swedish Radiation Protection Authority, NKOM or the wireless industry that with newer communication systems the radiation is *decreasing*, and this observation is used to infer that health effects will be reduced, too, this conclusion is based on false premises: The conclusion is a fallacy based on measurements carried out according to a method becoming increasingly irrelevant for biological effects as technology develops.²³⁴

In addition to this, we have also seen in Section 2.1 that sharp pulses do not weaken as quickly with distance, and that their biological effect is not as dependent on energetic power as assumed by traditional thinking on which our radiation protection guidelines are based.

The fact that the biological effect does not follow the signal's energy density – i.e., that there is no such clear dose-response relationship between energy intensity and biological effect – seems to be a main reason why so many are confused by conventional measurement results, drawing the conclusion that some people's acute physical reactions to AMS/smart meters must be due to imagination (nocebo).

Also in homes where AMS/smart meters have been installed for some time and measurements show that the transmitters have long since settled down from their max output, people still have problems that they are convinced they can clearly link to the meter. For example, that they, in case of Aidon

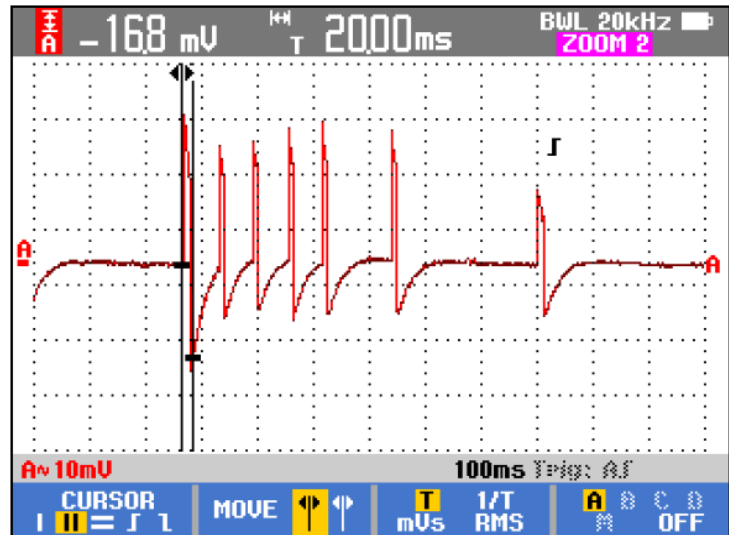


Figure 30: Pulses from an Aidon AMS meter.
0.1 second between routes (EMF-Consult)

234 Flydal, E: [Danish expert commentary: The Norwegian Radiation Protection Authority's measurement report hides the fact that there has been more harmful exposure in Kristiansand - and in Norway in general](#), blog post 14/09/2016

meters in Norway, wake up every hour, i.e., when the meter transmits consumer data, get headaches, or the like, while these symptoms vanish when they are away from the house, e.g. in a hut without an AMS meter.

If the measured power density is low, but you still have symptoms, the explanation could, as previously mentioned, also be that you have become more sensitive than before. However, it could just as well be that the cause of the problems is precisely what underscored here: that the pulses are the problem, not the power density.

The EUROPAEM guidelines' recommendations are expressed as recommended power density ($\mu\text{W}/\text{m}^2$), since this is the commonly used unit of measurement – although it is misleading. The guidelines therefore give recommendations depending on the system's pulsing characteristics, which is part of what is called that specific communication system's "protocol".. For systems with low-frequency pulsing, EUROPAEM's recommendations are stricter (Figure 12), as such pulsing has been demonstrated to be more bio-active.

Hence, if you compare the measured values with ICNIRP's guideline values, the radiation is certainly negligible. So, then you have to believe that the health problems are due to some other factor, e.g., pure imagination. On the other hand, if you compare the measured values with EUROPAEM's recommended maximum values, it becomes easier to understand that some people may have health problems: The radiation's energy intensity is often thousands of times too strong to be protective when combined with that specific communication protocol, according to the EUROPAEM guidelines.

Anyone who wants to prove that radiation from a transmitter at some specific location is "very low", should therefore compare with the ICNIRP recommendations for protection against overheating. However, if you want to check if radiation at some specific location is higher than recommendable from a precautionary standpoint, you should compare to the relevant row in table 3 in the EUROPAEM guidelines.

Hence, when the Norwegian Radiation Protection Authority describes the radiation from AMS/smart meters as "far below one thousandth of the limits",²³⁵ the statement is based on measurements carried out by the Norwegian Radiation Protection Authority, NKOM²³⁶. Thereafter, NKOM compared measurements to ICNIRP's reference values, which apply as Norwegian limits and calculation rules, and used the conventional methodology. You find the results on the far right in the table from NKOM's measurement report in Figure 31: The exposure is here averaged over six minutes, and the radiation comes out as being next to nothing. It naturally follows from such logic that the radiation should be completely harmless.

When dealing with short pulses such calculations give senseless numbers: Whether pulses are sent periodically, regularly and often, for example, as two ultra-short, ultra-strong pulses per second, or intermittent and irregularly as bursts at intervals of minutes in between, the average would be the same and almost zero, while biological impact could be very different.

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

236 https://www.nkom.no/forbruker/elektromagnetisk-stråling/elektromagnetisk-stråling/måling-av-feltstyrke-stråling/_attachment/32312?_ts=161751ce30a [Link no longer available]

Meter Type	Frequency (MHz)	Peak Power in pulses (W/m ²)	% of exposure limit at continuous transmission	% of exposure limit if maximum transmission time used	% of exposure limit when averaging over 6 minutes
Kamstrup					
MP1	444.7	0.02	8.85	1.77	0.0001
MP10	444.7	0.022	9.74	1.98	0.00011
Nuri					
MP5	872.5	0.005	1.13	0.11	0.000006
Aidon					
MP8-1	871.85	0.032	7.22	0.72	0.00004
MP11-1	872.5	0.01	2.4	0.24	0.00001

Table 1: The table shows power density in the short term signals, exposure relative to the limit value as if the meter is transmitting continuously, and exposure relative to the limit value averaged over time, as if the transmission time is at its maximum in relation to the requirements in the free use regulations. It also shows exposure of one signal averaged over six minutes. All values in the table are given relative to a standard distance of 1m.

Figure 31: Table from NKOM's report on power densities at 1m distance from meters showing exposures being far below recommended limits.

(‰ : Thousandths of the limits recommended by the Radiation Protection Authority.)

However, if you compare NKOM's measurements with the recommendations in Table 3 in EUROPAEM 2016, where impact from pulse patterns are taken into consideration, you will reach quite different conclusions:

In Figure 32, the three left-side columns are from NKOM's table (above). They are juxtaposed to a column where "Peak power pulses" are noted in the form normally used ($\mu\text{W}/\text{m}^2$), and then, on the far right, EUROPAEM's recommendations for the normal population, drawn from EUROPAEM's Table 3.

Meter Type	Frequency (MHz)	Peak Power in pulses (W/m ²)	Peak Power in pulses ($\mu\text{W}/\text{m}^2$)	EUROPAEM 2016 Recommendation	
				Day	Night
Kamstrup					
MP1	444.7	0.02	20 000	10	1
MP10	444.7	0.022	22 000	10	1
Nuri					
MP5	872.5	0.005	5 000	10	1
Aidon					
MP8-1	871.85	0.032	32 000	1	0.1
MP11-1	872.5	0.01	10 000	1	0.1

Table 1: The table shows power density in the short term signals, exposure relative to the limit value as if the meter is transmitting continuously, and exposure relative to the limit value averaged over time, as if the transmission time is at its maximum in relation to the requirements in the free use regulations. It also shows exposure of one signal averaged over six minutes. All values in the table are given relative to a standard distance of 1m.

Figure 32: Table from NKOM's report vs. EUROPAEM's recommendations

EUROPAEM's guidelines distinguish between day and night: At night the body tolerates less, for the extra sensitive, EUROPAEM recommends dividing by 10.

Now we can use the right-hand side of the table – i.e., the one we have added – to compare the radiation, measured as the peaks of the pulses (peak power density), with EUROPAEM's recommendations.

We then see that the radiation from the smart meters is, at a measuring distance of 1 metre, from 5,000 to 320,000 times stronger at night than the recommended maximum. And if you are electrically hypersensitive, EUROPAEM recommends multiplying by ten.

NB! In our table, the Aidon meters have, somewhat arbitrarily, been attributed a stricter maximum value based on the pulse frequency of 0.8 seconds – compared to 2 seconds or more for Nuri and 15 minutes for Kamstrup (as shown in Figure 12). If we did not, it would not really change the general picture.

Lowering exposure as measured by a measuring device for radio-frequency electromagnetic fields, whether it is done by switching off radiating sources or by turning down the effect or by creating some form of shielding, is very unlikely to be harmful. However, lower exposure in terms of power density alone is no guarantee that biological impacts will vanish.

The next section tells us that it might even be the opposite – whether we are talking about acute, noticeable effects (electro-hypersensitivity) or long-term effects.

5.4 Can't the exposure limits be set low enough?

Setting exposure limits is a political, not a scientific task: It is about willingness to accept risk.

Humans, like other organisms, have extremely complex sensitivity to electrical and magnetic fields at all levels. We have not even clearly identified which properties of electric fields have a biological effect, neither do we know if that is the right way of stating the problem. We know a number of active properties, as we saw in Section 4.2.5, but by no means all of them, nor how they interact. All limits will therefore be based on some degree of guesswork. Indeed, the University of Oslo's textbook; "Biological effect of low-frequency electromagnetic fields" describes using power density as the sole criterion for measuring health effects as "pure speculation".²³⁷

In such a situation, it is a political choice how much consideration should be given to what is poorly known: Should we take the chance that it will go well – at least for most? What damages or risks or hazards are big enough to count? Do we have a good enough overview of them? Or should we protect ourselves by being extra careful?

In an era when major technological shifts are happening quickly and globally, humanity is given little opportunity to fail before the damage has become irreparable and the investment too large to be allowed to fail. This creates extra risk.²³⁸

Several researchers go further than just pointing out that making standards and setting limits are politics, not science. The biophysicist Fritz Albert Popp, a pioneer in the field both in Germany, the USA and the Soviet Union, concluded as follows in 1980:²³⁹

"As for coupling mechanisms between electromagnetic fields and biological systems [...] biological "resonances" appear throughout the range from a few Hz to 10¹⁵ Hz (Hertz).²⁴⁰ They are the reactions of the living experimental organism and shows its sensitivity to becoming exposed to electromagnetic radiation with very specific frequencies. [...] For example, such resonant frequencies lie in the ELF range (= Extremely Low Frequency) at approximately 10 Hz to 100 Hz for larger vertebrates.

237 Vistnes, Arnt Inge: Biological effect of low-frequency electromagnetic fields, Department of Physics, University of Oslo, <https://folk.uio.no/arntvi/ffv99.pdf>, also published in "Fra Fysikkens Verden" no. 2 1999 (page 42- 47)

238 E.g. the German sociologist Ulrich Bech is concerned with this great risk in modern society: Beck, Ulrich. (2009). World at Risk. Cambridge: Polity Press.

239 Popp, FA, Phys. With. u. Rehabil., 21/6, S. 334-338 1980, cited in Sønning & Baumer (p.m.) 2013, op. cit., see note 241

240 10¹⁵ Hz means 1 pHz (petaHertz), which is equivalent to 1,000,000 GHz and are frequencies somewhere in the X-ray and gamma-ray range.

[...] There is no range throughout this wide biologically active frequency band that does not contain so-called resonant frequencies."

Life processes are closely linked to electricity. Biological systems are affected by fields as weak as the *natural background radiation* and even by variations as weak as the *changes in the natural background radiation*: birds navigate by them, bees and bacteria too. Our circadian rhythm and metabolism are affected.

Even the smallest and weakest signals can, under given circumstances, have an *information value* that is crucial for a chemical process. We found this to be the case with the weak pulses from the weather fronts (Section 4.2.6) – *pulses with a frequency as low as 1 Hz and durations from 30 to 300 nanoseconds* (billionths of a second), created as far as *80 miles away!*²⁴¹ Given such facts, it is simply beyond imagination that one would find safe limits to protect against any and all health damage from man-made electromagnetic systems.²⁴²

Some prominent scientists claim that the way electromagnetic fields affect us can simply not be grasped by those sciences which have so far dominated the field of radiation protection, and they rail against those scientists who do not realise the inadequacy of the old science. One of them is Prof. Dr. Karl Hecht, a “big shot” within the research environment of the former GDR (German Democratic Republic/East Germany), the Soviet Union and now Germany, stating:

*“Anyone who still tries to 'research' the life processes of the inseparable bio-psycho-social entity of the human being with an outdated and obsolete methodology – while ignoring all scientific progress, e.g. within quantum physics and quantum medicine, and does not demonstrate knowledge of such disciplines as neuropsychophysiology, neuropsych-immunology or neuropsych-hormonology – cannot call himself a scientist. He violates his scientific duty of care and acts irresponsibly towards human beings, the suffering ones, the sick, the healthy, the children, the pregnant women and thereby towards the life to come.”*²⁴³

The argument is thus that the influence of man-made electromagnetic fields is by far strong enough to interfere with biological processes, that such fields can have an impact almost unrelated to power density, and that electromagnetic fields are in such extensive use throughout the body both in humans and other life forms, that there is no known free space to exploit without possible risk occurring. On the contrary, the man-made radiation in the microwave range is increasingly made similar to natural pulses that affect us – without being registered by the measurement method used by the dominating standard setting bodies, nor considered when assessing health risks:

“In the pursuit of technological and commercial optimisation, the pulsed high frequency radiation of mobile telephony – especially by its low-frequency components – has in part increasingly approached the natural radiation fields of the environment. [...]

241 Walter Sönning & Hans Baumer (p.m.): Mobile telephony and its 'limits' - On the deliberate confusion of terms in the electrosmog problem, competence initiative e. V., 2013, https://kompetenzinitiative.com/wp-content/uploads/2019/08/ki_fb_soenning_grenzwerte_akt13.pdf

242 The following are mentioned as examples:

Dr. Ross Adey, quoted in BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Radiation, at www.bioinitiative.org, December 31, 2012;

prof. Karl Hecht i 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. Order No. 4231/630402.

Summary of content of a study of Russian-language literature from 1960 – 1996. [A popular scholarly version is available as Hecht, K. "The value of the limits for mobile phone radiation", competence initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>]

243 Karl Hecht, cited in Sönning & Baumer 2013, op. cit., see note 241

Precisely this, however, must almost inevitably make it a potential disturbance overlapping and causing chaos in the entire organic world.”²⁴⁴

This message can hardly be conveyed in a more serious and gloomy way. Still, it corresponds, for example, to the picture drawn by the American bio-geneticist Martin L Pall, coming from a completely different research environment, in his open letter to the legislative authorities in California (see its Chapter 5).²⁴⁵ It depicts an already ongoing increase in general morbidity and a slow but accelerating genetic decay due to exposure to microwave electromagnetic fields.

As a consequence, these researchers confront politicians and other central authorities – including specialist authorities for health, the environment and radiation protection – with the question of how sustainable they want policy to be. In Karl Hecht's wording during a hearing organised by the Green Party in Bavaria in 2006:²⁴⁶

“The point is simply that we either have to change or we will disappear from the face of the Earth!”

From a health policy and sustainability perspective, and based on the scientific knowledge explained so far in this document, the conclusion should be quite simple:

There is a need to change course, reduce, shield and remove microwave radiation in its current form, and possibly develop – or revert to – technologies that produce significantly less biological damage.

Development has mainly gone in the opposite direction. How this happened, *despite all this knowledge*, is the subject of the next chapters.

244 Sönning & Baumer 2013, op. cit., see note 241

245 <http://electromagnetichealth.org/wp-content/uploads/2017/08/Pall-Letter-to-CalLegis-FINAL-8-7-17.pdf>

246 Sönning & Baumer 2013, op. cit., see note 241

6. "The thermal paradigm" – from knowledge to a fight for stakeholder interests

In the previous chapters, it has been repeatedly referred to "*the thermal paradigm*" – i.e. the notion that in the case of non-ionizing radiation, roughly the frequency range from light down to zero (see Figure 5), only *heating above a certain level* could cause acute harmful effects from radiation, and that no else effect had been shown. After all, although only small parts of present science have been presented in the previous chapters, you can easily see that this idea is in stark contrast to that research.

Reference has also been made a number of times in previous chapters to the *ICNIRP*, the German foundation which has been given a particular position for providing advice to the WHO and to other parts of the UN system as to radiation protection within the non-ionizing spectrum.

The topic of the this chapter is how this "thermal paradigm" arose, and how it is maintained – with such strong mechanisms that employees in the Norwegian Radiation Protection Authority and elsewhere in Norwegian administration *actually seem convinced* that "the thermal paradigm", and the professionals and their committees defending it, belong to the *mainstream* of research. Also, they may be convinced that their conclusions are *representative* of the knowledge on health risks from microwaves and other so-called non-ionizing radiation, although this is not the case at all.

This is, as we shall see, all about *building* a way of thinking and *creating* the research, the organisations and networks – in short: the justifications maintaining and defending what is a long outdated understanding.

For the author of this text, personally, it has been very difficult to accept such a picture of a regular battle of interests – a battle in which the influence of the wireless industry has been decisive. After almost 40 enthusiastic years as a researcher, bureaucrat, project developer and manager, strategy adviser and university lecturer within telecom and ICT in general, it has been hard to accept.

Not the least, it has been challenging to realise that research findings can be managed in such a way that many researchers studying effects from electromagnetic fields themselves do not understand how they are abused as the industry's "useful ignoramuses"²⁴⁷. Easily seduced are also other professionals within the industry, both in business and public administration, while they pursue their various tasks.

Who are the ones governing this game? Probably no specific people at all, but the sum of forces at play: No one sits somewhere in the background wanting to hurt us. The forces at play are pension funds seeking the highest return on investments, managers who make their decisions based on information they think is reliable as it comes from professionals, whether scientists or consultants, consultants wanting to please their clients, militaries seeking to keep their budgets while also secure our borders, bureaucrats and strategists, salespeople and technology developers who do their best to achieve their goals, and politicians with larger visions but no interest in the details.

The "Story about the thermal paradigm" is therefore not just a story in black and white about heroes and villains, but also of processes where the motives may be many, legitimate as well as illegitimate, ranging from personal gain and career to professional interests or high-valued political goals of welfare. The personas in this story may sit at any side of the table.

So, if someone takes on villainous roles, it *may* come from sheer ignorance, narrow perspectives and goals, or trust in authorities who were not worthy of trust. For example, in the business managers' or economists' world view, radio technology's side effects easily takes the form of

²⁴⁷ The Greek "idiot" or Latin "ignoramus" means "ignorant". Of course they are not idiots in the sense of "stupid".

"externalities", something "we have appointed people to study and handle", or something that is simply beyond the engineers' horizon and responsibility when they develop new systems. Knowledge about health effects from radio waves has simply been repressed, too – or left to biophysicists and some specialist communities to occupy themselves with.

Regardless of individuals' motives, the resultant force – the sum of the forces – has led technology development in the direction opposite to the one suggested by the large amount of scientific knowledge we have looked at in previous chapters.

The above claims might seem patently unreasonable to the reader, and whoever puts forward such claims, bears the burden of proof. The following therefore takes the reader through a brief history tour – with various side tracks.

My description is based on my own relatively recent knowledge of the subject, so the following narrative has its flaws. Some sources I have read in their entirety. Many sources in my bookshelf I have not been able to familiarise myself with yet, so they have not been included. There are parts below I would wish were more thoroughly documented than time permitted. Many details are lacking, but the main pattern seems unquestionable and is described in more detail in a number of other sources.²⁴⁸ Since Norway 2018 seems void of any such historical overviews in Norwegian and written for the larger public, I found such an undertaking useful and necessary anyhow.

My small historical walk through provides the opportunity to find reasons for why there are in fact *significant amounts of research reports that find no connection at all between exposure and health risk*. Such findings do exist. How come?

6.1 The history of radiation protection, ICNIRP and the WHO

A brief look at radiation protection history shows us that "Things Take Time" and that in society and politics, knowledge and practice do not necessarily correspond:²⁴⁹

The idea to set limits for radiation exposure appeared immediately after the discovery of X-ray waves in 1895. The first fairly simple recommendations as to how to protect oneself – with reference to the three factors *duration, distance and shielding* – were produced in 1896.

Some authors divide the development of radiation protection during the first fifty years into three periods: *The pioneer period* (1895-1905), when the great potential for damage was discovered, *The*

248 Some sources of the big picture drawn here are:

Paul Brodeur: *The Zapping of America*, Norton & Co, N.Y., 1977; Don Maisch: *The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation*, PhD Thesis, Univ. of Wollongong, 2010, <http://www.emfacts.com/the-procrustean-approach/>;

Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>;

Vilhelm Schjelderup: *Electromagnetism and life*, 2nd rev. edition, Kolofon, 2006 (Norwegian only)

[In 2023, when this my text put together in 2018 is translated into English, I could have added numerous documents. To understand the historical background of today's regulatory regime, I would first and foremost add Nicolas Stenecks "The microwave debate" (MIT Press, 1998, which I translated into Norwegian in 2022.)

249 The sections on ICRP below are based on R.H. Clarke and J.Valentin: *The History of ICRP and the Evolution of its Policies*, ICRP Publication 109, Annals of the ICRP, Elsevier, 2009; Ronald L. Kathern and Paul L. Ziemer: *The First Fifty Years of Radiation Protection --A Brief Sketch*,

<https://sites.google.com/isu.edu/health-physics-radinf/history-of-radiation-and-radiation-protection/first-50-years>, excerpt from the book *Health Physics: A Backward Glance*, R. Kathern and P. Ziemer (Editors), Pergamon Press, 1980;

Pooja Khare, Preeti Nair, Amit Khare, Vandana Singh, Rhiti Chatterjee: *The Road To Radiation Protection: A Rocky Path*, Journal of Clinical and Diagnostic Research. 2014 Dec, Vol-8(12): ZE01-ZE04, DOI: 10.7860/JCDR/2014/5832.5223

Sleeping Beauty period (1905-1925), when people were mostly concerned with possibilities of use and gained more understanding of what radiation is and how it worked, and *The epoch of progress* (1925-1945), when *radiation protection* became a separate science and *health physics* became a separate subject.

The idea of *measurable standards for exposure limits* emerged slowly in the wake of injuries suffered by scientists and workers from handling radioactive material. There were many: In 1936, a monument with several hundred names was erected outside The Röntgen Society in Hamburg in memory of the "X-ray and radium martyrs".

Discussions about how exposure should be measured in order to identify the aspects of radiation being linked to health risks, started around 1925. However, standard development did not gain momentum until an international organisation, *ICRP, International Commission on Radiation Protection*, was formed. In 1956, ICRP joined the WHO, and in 1959 it became affiliated to the International Atomic Energy Commission (IAEA), the International Labour Organization (ILO), the Food and Agricultural Organization (FAO), the International Organisation for Standardisation (ISO) and UNESCO, the United Nations Educational, Scientific and Cultural Organisation.

Since the mid-1950s, the ICRP guidelines have contained the ALARA principle – the principle that radiation must always be kept *As Low As Reasonably Achievable*.

The history of the ICRP and the history of radiation protection is, moreover, a story of repeated new recognition that exposure limits should be lowered further than so far thought necessary, and a story of constant lack of money – until the Ford Foundation made a significant contribution in 1960, so that the ICRP could afford a paid secretariat and to cover its travel expenses.

At the ICRP conferences, the issue of exposure limits for radio waves and electricity grids was raised repeatedly, but was given low priority. With the pending risk of nuclear war and in an era in which the use of radiation in medicine created revolutions, there was simply no room in the ICRP, neither capacity nor budgets, to accommodate radiation protection work on such areas perceived as far less important and less consequential.

Against this backdrop the ICNIRP was created – a foundation with the mission of developing standards for radiation protection against *non-ionizing radiation*, a field step-motherly treated within the ICRP, in clear need for exposure limits to protect the general public as well as those particularly exposed in their work, as well as for international standardisation to solve trans-national issues, e.g. product specifications, and to facilitate information exchange. However, ICNIRP seems to have been “captured by industry” from its conception:

ICNIRP, *the International Commission on Non-Ionizing Radiation Protection*, is a German registered scientific foundation, and not a member organisation for countries like the ICRP. The foundation was established in 1977²⁵⁰ with funding from the mobile phone industry.²⁵¹ It originated as a breakaway organisation from the *International Radiation Protection Association* (IRPA), another international organisation for radiation protection, today with 65 member states, as well as local societies more or less convergent with governmental radio protection agencies.

ICNIRP quickly built up a network similar to ICRP, and thus became a kind of standard supplier to WHO, ILO and other international organisations in the field of electricity, etc. ICRP continued focusing on *ionizing radiation*, while ICNIRP quickly became an important player in its field, despite its modest size.

250 <https://www.icnirp.org/en/about-icnirp/aim-status-history/index.html>

251 Maisch, Don: *The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation*, PhD-avhandling, Univ. of Wollongong, 2010, <http://www.emfacts.com/the-procrustean-approach/>

Compared to its power, ICNIRP is a very small organisation. It consists of a secretariat that is housed in *one single office room* at the German Radiation Protection Authority outside Munich. According to the secretary there when this author visited, the secretariat consists of a management of two persons who are rarely on the premises. ICNIRP also has twelve *members*, selected by the management. They are supposed to be independent experts within relevant fields of science. [As of 2023, the chair is a psychologist.] Members can be members for a short time or up to many years. In this way, a high impact network is created over the years, consisting of people having developed a common mindset. Or the other way around: From a network of people with common mindsets, some of them come together and create guidelines forming radiation protection policies. Their names pop up as consultants to the WHO and ITU – the International Telecommunications Union – and in various regional or national scientific committees, creating the basis of radiation protection policies. It is this network, and the good connections within it, which gives ICNIRP such great influence.²⁵²

Who owns or controls the ICNIRP foundation is not known. The foundation selects its management all by itself. This means that ICNIRP is – at least formally – completely self-driven, and completely uncontrolled by governments, nor transparent in its whereabouts.

In the past [as of 2018], Nordic members of ICNIRP have among others been *Maria Feychting* from Sweden and *Gunhild Oftedal* from Norway. Feychting was a principal member of the committee behind the literature review forming the knowledge base for today's Norwegian health risk assessments (FHI report 2012:3). Oftedal wrote the very brief research review invoked as a basis for the committee's conclusion that electro-hypersensitivity is not found to be related to exposure to electromagnetic fields. (Discussed previously in Section 2.3.)

ICNIRP, according to its own statement, provides "scientific advice and guidance on the health and environmental effects of non-ionizing radiation (NIR) to protect people and the environment from harmful NIR exposure".²⁵³ In addition, ICNIRP organises seminars and has a work program for topics to be covered. The accounts for 2017 were only "140,555.00" in total income, currency not specified.²⁵⁴ I have since learnt from emails from ICNIRP, that the currency is Euros. It is still very small, barely enough for a secretary and stamps. In the annual report, though, it is stated that the figure is only "an indication"!

ICNIRP also carries out some missionary activities. Thus, Hecht²⁵⁵ writes that Russia has been visited several times by representatives of the WHO and ICNIRP, putting Russia under pressure to implement the much more lax Western standards.

ICNIRP has produced a number of guidelines, or *standards*. Such work is time-consuming and builds on previous guidelines, and such processes are normally characterised by compromises, as is the case in much international work. Guidelines used by many, help to harmonise technology and thinking and make global trade and production easier and less expensive – and thus markets bigger. Therefore, common standards are crucial for world trade and for free trade. So, standardisation work has many desired effects and is considered important worldwide.

In order to get ICNIRP's guidelines marketed, the Australian Michael Repachioli, the man behind ICNIRP, quickly got a small office in WHO up and running, called *The International EMF Project*, largely financed by the industry. Formally, the task of this office is to disseminate common standards around the world. The arguments we find in WHO's material are general welfare goals: radiation protection, efficient trade and standardisation. In practice, we are talking the ICNIRP guidelines or the similar IEEE guidelines.

252 See also Flydal, E: [On a surprise visit to ICNIRP](#), blog post 15/10/2015

253 <https://www.icnirp.org/en/home/index.html>

254 ICNIRP Activities Report 2017, https://www.icnirp.org/cms/upload/doc/Annual_Report_2017.pdf

255 Hecht 2009, side 41. see note 68.

The WHO is an organisation in constant need of money. It is easy to imagine that it was welcome for the WHO to take a (paid) role in promoting radiation protection by advocating guidelines others bear the cost of creating. Eventually, it also led to collaboration on research on the health effects of mobile phones – where the mobile industry took a significant part of the bill, and the WHO organised and received much of the credit (the INTERPHONE project).

ICNIRP's first guidelines for electromagnetic fields came in 1998.²⁵⁶ The key point to make about these guidelines is that they explicitly aim to protect only against acute heating (in the high frequency range) and against hallucinations or other neural stimulation (from low frequency radiation).

According to the 1998 ICNIRP Guidelines, the research results were too unclear to form a basis for guidance and suggestions as to limits to prevent against health effects other than *heating injuries* from high frequency radiation. For this reason, the ICNIRP guidelines leave it to employers and countries *to adapt the limits themselves* to protect against other types of damage, and to do so by regularly conducting *reviews of the state of scientific knowledge*.

The aforementioned FHI report from 2012 is such a study. Also, The Swedish Radiation Protection Authority has a standing committee which issues such a report approximately every two years. Other countries have theirs, and the EU also carries out such investigations from time to time (e.g. by its committee SCENIHR, the EU Commission's Scientific Committee On Emerging And Newly Identified Health Risks).

The WHO has come out with the same message as ICNIRP: In brochures it says that the process should be rational, based on facts and science, and not fall victim to emotions and superstition. Furthermore, that one should use sound criteria for how science is to be assessed, i.e. such as those set out in ICNIRP's 1998 guidelines.

It is worth taking a look at the assessment criteria, as you will see that they are good, strict and reasonable in order to arrive at reliable knowledge. But whether they are suitable when faced with effects from complex phenomena poorly understood plus stimuli and effects of kinds difficult to quantify or to treat as physical phenomena that can be counted and weighed, is a different matter.

In any case, ICNIRP's instructions – however well-intentioned they might have been – ensures that a lot of power is transferred to the *committees reviewing the status of knowledge*. These committees thus play a central role in the knowledge processes:

If the committees conclude that there is no need for stricter radiation limits than those needed to protect against acute health issues from heating, this view will be adopted by countries and employers, themselves not having the capacities nor the suspicions necessary to underpin alternative views and policies.

We will return to that.

This situation is illustrated in Figure 33: A *network of organisations* supplying each other and obtaining advice from each other, shapes the international frameworks for radiation protection through their collaboration. The *expert assessments* – which the committees hand over to poorly staffed radiation protection agencies, always conclude with the same statements – *that no new risk has been demonstrated as long as the radiation is below "the thermal limits"*.

256 ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), Health Physics 74(4):494-522; 1998



Figure 33: A network of influence paths, with committees that always have the same conclusion

It may seem strange that the expert assessments are so similar. It is not so surprising when you look at who is participating where in this network:

Below follows a list of those who, as of 20 January 2017, were members of the Swedish Radiation Protection Authority's (SSM) expert council for non-ionizing radiation. From this assembly, it would be sensational – to say the least – if a statement were to come out stating that "Yes, clear acute health damaging effects of EMF have been demonstrated at non-thermal exposure levels, as well as health effects from such long-term exposure." For the vast majority, like their predecessors in the council, they have linked their careers in international radiation protection bodies to rejecting any such possibilities.

Many of these people are members of national and international bodies for radiation protection assessments, standardisation and research, in which they most likely meet, to do more or less the same job: evaluating scientific research on non-ionizing radiation and health effects.²⁵⁷ We also see that several of them have their professional background from physics and work with *ionizing* radiation, i.e., precisely such professional environments providing blinkers when dealing with non-ionizing radiation:²⁵⁸ By looking at their publications registered in PubMed, a large database for medical research articles, we get an impression of where they stand professionally:

- Leif Moberg, PhD, the SSM council's leader: A physicist with a career up the ranks at SSM since 1977 from laboratory technician to research manager. His field has been ionizing radiation, and he held various positions in the UN system related to nuclear accidents. Available in PubMed with one paper, which is about Swedish nuclear power plants.

257 The list is from 2017 and was neither complete nor completely up-to-date. It is to an even lesser extent now in June 2018.

258 This and the following paragraphs are taken from Flydal, E: [Who decides if your WiFi router is dangerous to health? - The labyrinth until Tordenskjold's soldiers](#), blog post, 20/01/2017

- Lars (Henry) Mjönes (73), B.Sc., the SSM council's scientific secretary since 2012, researcher at SSM for a number of years. For a number of years he stood behind the thermal dogma as "the only proven health risk", at the same time maintaining that "it is too early to draw definitive conclusions" (2011) and that "there are no known health risks with radio waves from mobile base stations and wireless data networks, but it is not yet possible to completely rule out health risks for anyone who uses a mobile phone for a long time, more than ten years." Mjönes is now (2018) affected by thyroid cancer, a form of cancer on the rise in the Nordics, statistically linked to mobile telephony.
- Eric van Rongen, PhD, radiobiologist (i.e. *ionizing* radiation), a veteran in this business and [as of 2018] head of ICNIRP. He is the scientific secretary for a subcommittee on EMF in "De Gezondheidsraad", an independent advisory body to the Dutch health authorities. Also Anke Huss (see below) is a member there. Dr. van Rongen is also a member of ICNIRP, IEEE and COST, and takes on work for WHO's The International EMF Project. Twelve papers in PubMed, several of which cannot be considered research, but policy documents. All these papers argue that the findings are uncertain or negative (i.e. that no health risk has been demonstrated).
- Martin Röösli, epidemiologist (statistician within medicine), senior researcher and lecturer at the Swiss Tropical and Public Health Institute (TFI), University of Basel. He is a member of ICNIRP and a couple of COST working groups for health assessments; the steering group of ZonMw – the Netherlands Research Council for Health Research, and in the crisis council of Japan's EMF Information Centre. He also takes on work for WHO's The International EMF Project. Röösl*i* was involved in the WHO's cancer institute (IARC)'s major study which gave microwave radiation a class 2B possible carcinogen status, and was among those who believed that the statistics were not good enough. He heads the Swiss sister body to SSM's council: the advisory committee for research evaluations BERENIS, under Switzerland's Environment Department. Listed in PubMed with 110 research articles. His articles that concern EMF do, with some notable exceptions, not find any significant impacts.
- Maria Rosaria Scarfi, PhD, cell biologist, researcher at Italy's National Research Council, Naples. She has been an adviser to ICNIRP, takes on work for WHO's The International EMF Project, has participated in investigative work for the EU Commission's SCENIHR, and in COST working groups. As of 16 November 2016, she has (co)authored a total of 157 research contributions listed on the Italian Research Council's website. A consistent picture is that she finds *no influence* from EMF, *no significant influence*, or *beneficial influence* from weak exposures (hormesis, see also section 4.2.1).
- Emilie van Deventer, Dr, observer in SSM's council. Canadian antenna specialist who very surprisingly became head of WHO's The International EMF Project a few years ago. Holds office in the IEEE. Six relevant papers in PubMed. In several of these, van Deventer is co-author with van Rongen, Repachioli, Kheifets and other well-known names among the "no effects" partisans. The papers conclude that the risk has not been reliably demonstrated and that more research is needed.
- Prof. Clemens Dasenbrock, Head of Dept. for Toxicological Testing of Environmental and Occupational Safety, Fraunhofer Institute, Hannover. Eight relevant articles in PubMed, several with other well-known names among the "no" partisans, including Martin Röösl*i*. Prof. Dasenbrock found increased incidence of cancer after Universal Mobile Telecommunications System (UMTS) exposure, possible but unclear link to leukaemia in another experiment, and no connection in an experiment with mice.

- Heidi Danker-Hopfe, PhD, biologist and statistician, professor at The Charité Medical University, Berlin, where she heads a sleep research department. Since 2006 member of the German Radiation Protection Authority's committee for non-ionizing radiation, since 2011 board member of the European Bioelectromagnetics Association, since 2012 member of the EU's SCENIHR, since 2013 member of SSM's council. She has 58 entries in PubMed. Of these, there are many about the therapeutic use of EMF in psychiatry and to improve sleep, and quite a few about the possible impact of GSM, UMTS (3G) and TETRA, demonstrated on cognitive abilities, but not on signalling in the cerebral cortex.
- Anke Huss, PhD, lecturer, Department of Risk Assessment Science, Dept. for Environmental Epidemiology (disease statistics related to environmental influences), Utrecht University, The Netherlands. Her publications are mainly about statistical survey methods and about environmental factors other than EMF. Several publications are authored together with Martin Rösli, in which no clear connections are found.
- Lars Klæboe, PhD, biologist/epidemiologist, researcher, Norwegian Radiation Protection Authority, Oslo. [Now in 2018 at the Norwegian Cancer Registry.] Heh has 20 entries in PubMed, all are statistical analyses, mostly on the risk of cancer from EMF exposure. Almost all the articles are co-authored with some of the "heavy" names of the "no effects" partisans, including Rösli, Feychting, Smidt and Schüz. The articles are characterised by the fact that they cast doubt on positive findings in other projects, while they themselves find no, or very uncertain, connections.

The members of the committee are thus linked together by various ties, they work together in several bodies, none of them has their specialisation in electromagnetic fields or bio-electricity, no one is a physician, and they all have in common that they all reject all research not supporting ICNIRP's heating based exposure recommendations as sufficient limits – again and again.

These are the people telling you, your employer and your children's daycare staff that WiFi routers are perfectly OK, and that the Internet of Things, "smart meters", tablets in the daycare and 3G, 4G and 5G are just fine. They do so despite a flood of practical evidence and scientific research demonstrating serious health issues to people, animals and plants. And they do it with the authority linked to their positions and to the weight of the agencies for which they work.

How many people actually read their full reports? Probably almost none. They are long, systematic and boring, often underscoring that much is not certain and that “more research is needed”. They also have a chapter telling about the needs for a strict and systematic working method that will ensure objectivity and thoroughness. They might even, as in some of the SSM council reviews, stress that such strict methods may be too restrictive. However, in the summaries, with the conclusions everyone reads, these uncertainties are understated, and recommendations are clear: “no need for change”.

What they do in their knowledge reviews – or what the committee secretary does, as he/she normally does the lion's share of the work – is simply finding some reason to disqualify every single paper demonstrating health damage or biological effects at sub-thermal exposure levels. Then, from the papers that found no connection between exposure and symptoms, they draw the conclusion that no connection has been conclusively demonstrated, hence no reason for the introduction of stricter exposure limits.

In May 2018, the SSM council, to which we have now been acquainted, issued a new state-of-the-knowledge report.²⁵⁹ The Swedish Radiation Protection Agency's website states:²⁶⁰

259 <https://www.stralsakerhetsmyndigheten.se/contentassets/f34de8333acd4ac2b22a9b072d9b33f9/201809-recent-research-on-emf-and-health-risk>

260 <https://www.stralsakerhetsmyndigheten.se/press/nyheter/2018/tolfte-rapporten-fran-stralsakerhetsmyndighetens-vetenskapliga-rad-for-elektromagnetiska-falt/>

“No new health risks have been identified. Whether the mobile phone causes brain tumours or not was investigated in the last two years mainly by studying changes over time. The results were not entirely clear, but mainly pointed to a lack of connection.

- Some cell and animal studies indicate that EMF exposure can cause oxidative stress even at low exposure levels, but it is unclear what significance this may have in terms of health effects in humans, says Leif Moberg.”

There are a number of such committees in different countries, always drawing the same conclusions.²⁶¹ When you review their members, you see that many of ICNIRP's people pop up in key positions. The committees lack medics, biologists and people with practical experience with feet on the ground. Instead, they have statisticians and physicists, people who – grossly simplified and at the risk of quite unreasonably offending someone – by orientation and professional background see what the statistics and models allow them to see. There is a striking difference between them and the biologists and medical practitioners that we find in the mainstream of research: The biologists and medical practitioners are used to the world being a complex place of which we only understand small parts and accept there are far more subtle mechanisms in play than we are able to model. In every single cell, there are Chinese boxes of complex, *dynamic, open systems*, striving to keep and restore balance – thus confounding scientists' observations.

In other words, ICNIRP's network of “no effect” partisans constitutes a kind of self-recruiting echo chamber – a professional guild of technologists, physicists and engineers associated with those communities that have a strong interest in discrediting ideas that oppose the thermal paradigm and which can reduce the scope and prestige of their business and professions. This network blends, more or less, with networks linked to IEEE, the WHO's The International EMF Project, and with other science and physics-oriented communities linked to the industry. The ICNIRP foundation and its close links to the wireless industry, the military and the defence industry were well described in the Norwegian broadcaster NRK's documentary "Ein strålande dag" ["A radiant day"].²⁶²

The fact that professionals collaborate or that they are involved in several authorities is not in itself objectionable. On the contrary, it is beneficial, necessary and effective. But it becomes objectionable when it creates a closed monopoly of opinion that prevents competing understandings – understandings that in this case obviously cover reality better, implying that questions can be asked about neutrality and balance in their counterpart's assessments.

This uneven playing field for scientific opinions is made even more so when impartiality is not hailed and organisations are not transparent and even self-recruiting. This is the case with ICNIRP. In the table below we see a small selection of members of the WHO's The International EMF Project's expert "Core Group" as of February 2017, and their positions. We see that ICNIRP is heavily represented. The implication is simply that WHO's advice in the field of radiation protection is ICNIRP's advice. The WHO has no weight of its own. This is also what we see with the committee that provides the Swedish radiation protection agency, SSM, with the assessments and conclusions that form the Swedish government's knowledge base. If we carried out the same analysis of the Norwegian committee from 2012 that shaped Norwegian health policy in the field for years to come, we would have seen the same picture once again.

261 A collection of quotes from such is presented on the website of ICES, International Committee on Electromagnetic Safety <https://www.ices-emfsafety.org/expert-reviews/>

262 The (Norwegian only) documentary "Ein strålande dag" ["A radiant day"], NRK Brennpunkt (23.09.2008), <https://tv.nrk.no/serie/brennepunkt/OAUA11001508/23-09-2008> and <https://www.youtube.com/watch?v=g-vKBXDVEJA>

Member of WHO's The International EMF Project's expert "Core Group"	Also member of:
Emelie van Deventer, Project Manager	IEEE, SSM, previously funded by wireless industry
Simon Mann	ICNIRP, UK expert group AGNIR
Maria Feychting	ICNIRP, SSM, Norway's and UK's expert groups
Gunnhild Oftedal	ICNIRP, Norway's expert group
Eric van Rongen	ICNIRP, IEEE, SSM, Netherlands expert group
Maria Rosaria Scarfi	ICNIRP, EU/SCENIHR, SSM
Denis Zmirou	France's expert group AFSSET

Figure 34: "ICNIRP people in all agencies" – sharing influence

Such networks are a democratic problem. They create empowerment in conflict with the need for balance and exchange between conflicting opinions on which our social model is based. Also, that such situations legitimize bringing forward accusations of lack of neutrality – that committees set to do very important jobs in our society are biased.²⁶³

The reports from the many literature review committees in which ICNIRP's network participates, reinforce this monopoly of opinion in that the reports largely refer back to ICNIRP's reports and to each other, and not to reports from committees with divergent conclusions.

The majority, labelled as those with deviant or alternative opinions, are simply shut out through a selection process that is not sound in terms of research ethics. Hence, it is no surprise that these committee reports are subject to heavy criticism. (See Sections 8.2 and 9.)

This staffing monopoly maintains an absurd situation where the world's leading researchers stand with "hats in hand", but with solid theory and repeated research findings in their briefcases. Instead of the other way around, theirs is the burden of trying to convince authorities that they themselves are right, and that ICNIRP and the expert committees are wrong. ICNIRP has its authority by virtue of its network and its conventional thinking based in ionizing radiation physics, so these researchers have poor odds when faced with governmental radiation protection agencies lacking expertise in the field of weak non-ionizing radiation's effects on biology. Such agencies therefore place their trust in research that does *not* find any detrimental effects – and that should not be given weight from the view of scientific research methodology (see section 4.2.1).

ICNIRP has succeeded. ICNIRP guidelines are followed in a majority of countries, covering approximately 59% of the world's population, however many of them with some more restrictive amendments. The rest have either none or far stricter regulations. (See Figure 1.)

This situation cannot be understood based on research results. It must be understood in political terms. It is the result of a battle of interests in which radiation protection administrations seem to play a secondary role as the guardian of historical traditions and a defender of military and commercial interests: In the Danish radiation protection there is not a single person employed in the field of non-ionizing radiation, only an oncologist as a part-time consultant. Hence, the literature review committees and their reports determine the country's radiation protection policy.

In Norway, we are not used to thinking in such disrespectful terms about government. Neither are we used to think that industry and defence should outperform government and make government agencies their "sleeping partners" – or even the pawns of the industry. Nor are we used to viewing

²⁶³ WHO is criticised for industrial infiltration and crazy experts, blog post, The Radiation Protection Foundation, 16 February 2017, <http://www.stralskyddsstiftelsen.se/2017/02/who-kritiseras-for-industriinfiltration-och-javiga-expert/>

public health being sacrificed. However, if we look back on the history of radiation protection, it is perhaps not surprising. The resources were so scarce for long periods, the ICRP was kept alive from the Swedish leader's private pocketbook.

In this country of ours, we also tend to think well of others, and are not used to the degree of cynicism sometimes behind strategy games where about life and money are at stake. Neither do we imagine how large processes in society may go wrong, even when intentions of all participants are only the best.

We must therefore go more closely into the details to understand how it all came into being.

7. How the thermal limits came about

Here is a brief account of how the limits were set in Europe – in the East and in the West.²⁶⁴ The starting point is the intense research and technology development – not the least on radio waves and radio communication, the technology that won the Second World War. Industrial use was underway. Radar technology was developing. Satellite communication and portable telephony were visible on the horizon – for those who could afford it. Mesh networks – which linked together wirelessly and maintained connections automatically – were also on the drawing board. In short, a period filled with great visions in the head of any radio engineer.

7.1 Two different approaches to limits

The Soviet Union did very extensive research into the biological effects of radiation both before, during and after the Second World War.²⁶⁵ Both there and in the most industrialised countries in the rest of Eastern Europe – Czechoslovakia, Poland and the GDR (German Democratic Republic/DDR), limits were introduced early on. These limits were believed to be sufficient to protect against *both acute and long-term health effects*.

The reasons for these limits were based on extensive short-term as well as long-term animal experiments and observations. Behind the Iron Curtain, extensive research into biological reactions was initiated in 1948. People were followed for more than 10 years, since theory and practice dictated that short-term exposures could not be used to investigate biological reactions: Biological systems manage – or at least try – to compensate for the exposure for quite some time. The scientists therefore did not find short-term experiments interesting.

Then they set the exposure limits at the levels at which they found that the body began to defend itself against the radiation.²⁶⁶ Exposure limits for short-term exposure were set somewhat higher for soldiers.

Time limits were set for how many hours one could be exposed. Limits were far stricter for pregnant women and if the radio signal was pulsed, as pulsed signals were found to produce a stronger biological reaction. Mandatory radiation hygiene measures were also introduced in the Eastern Bloc at exposed workplaces, among those measures were regular health checks.²⁶⁷ These also gave scientists data to analyse.

Around 1980, the exposure limits were as shown in the table in Figure 35 for the USA and Western Europe in comparison to parts of Eastern Europe:

²⁶⁴ As the rest of this book, it reflects the authors understanding by 2018. This chapter is mainly based on:

Hecht, K. "The value of the limits for mobile phone radiation", competence initiative e.V.; 2009;

Paul Brodeur: The Zapping of America, Norton & Co, N.Y., 1977; Maisch, Don: The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, PhD-avhandling, Univ. of Wollongong, 2010, <http://www.emfacts.com/the-procrustean-approach> As of my knowledge in 2023, I would have added a few more sources, first and foremost add Nicolas Stenecks "The microwave debate" (MIT Press, 1998.

²⁶⁵ The research in the Soviet Union is interestingly described in Schjelderup, Vilhelm: Electromagnetism and life: a confrontation between two superpowers' science, Dreyers forlag, Oslo (1987).

²⁶⁶ Michael Repacholi, Yuri Grigoriev, Jochen Buschmann og Claudio Pioli: Scientific Basis for the Soviet and Russian Radiofrequency Standards for the General Public, Bioelectromagnetics, 2012, DOI 10.1002/bem.21742

²⁶⁷ See text and table in Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

Duration per day	Maximum permissible average power density ($\mu\text{W}/\text{m}^2$)				Signal form
	USA, Western Europe	Poland	(former) Czechoslovakia	(former) GDR / DDR	
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 Union: 2 hours)	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 35: Limits in the USA/Western Europe and some Eastern European countries around 1980

The Soviet Union and the Eastern Bloc countries therefore had far lower maximum exposure limits for the general population than in the USA: Only around one thousandth. Moreover, as the table in Figure 35 shows, in the 1980s several countries had begun to take into account that exposure to *pulsed* radiation has a higher biological impact and therefore needed stricter limits.

Hence, the limits were set at these levels, because they took into account the research carried out on biological reactions.²⁶⁸ In 1989, decisions were made in the GDR to further tighten the exposure limits, since the knowledge now called for stricter limits.²⁶⁹ However, that was the year before the GDR was dissolved and became part of a re-united Germany.

There is no doubt that Soviet Russian and other Eastern European research results were well known in the USA: A great deal of Russian research was collected and translated as part of military intelligence. Other studies were openly published as collaborative projects between professionals. For example, a very comprehensive overview of the research on biological effects of natural and man-made electromagnetic fields, commissioned by the Soviet Russian Academy of Sciences, was published by Springer Verlag in New York as an East-West cooperative project in 1970.²⁷⁰

In a 1980 meeting report from the large and leading USA based organisation for electrotechnical development and standardisation, IEEE, one could read about the state of knowledge in Eastern Europe:²⁷¹

“A large body of literature on the biological effects of microwave radiation has been received from the Soviet Union and other Eastern European countries since 1973. This literature reports changes in almost all biological systems at exposure densities lower than $10\text{mW}/\text{cm}^2$ [i.e. below $100 \mu\text{W}/\text{m}^2$, EF]. Since 1976, an increasing amount of data has been published from long-term exposure to microwaves at power density levels lower than $10\text{mW}/\text{cm}^2$. An overview of research results that have been reported since 1976 is presented in this report.”

268 Karl Hecht: Effects of Wireless Communication Technologies A Brochure Series of the Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V., Brochure 6, 2016,

https://kompetenzinitiative.com/wp-content/uploads/2019/08/KI_Brochure-6_K_Hecht_web.pdf

269 Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009,

<https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

270 Presman, A.S.: Electromagnetic Fields and Life, Springer Science, 1970

271 Soviet and Eastern European research on biological effects of microwave radiation, Proceedings of the IEEE, Volume: 68, Issue: 1, Jan. 1980, <https://ieeexplore.ieee.org/document/1455855/>

A total of 33 references to Soviet Russian overview studies were attached to this report, all of which had been translated into English. The report was submitted by D.I. McRee at the National Institute of Environmental Health Sciences, Research Triangle Park, NC, one of the US military's largest research centres.

7.2 How the limits became so different in the USA

The choice of exposure limits in the USA was simply made on a very practical and rather short-sighted basis. At least in hindsight, science appears as just a fig leaf used to legitimise the choice. In its main features, the story is as follows:

In the West, after World War II, the United States was the leading force in the development of radar and communication technologies. As in the rest of the world, the understanding of both the health risks and how electromagnetic fields could cause harm, was quite limited. One thing was what the scientists knew. The engineers' approach, and what people in the world of the military and business bothered to find out, was a different matter. There were therefore, nothing more than very general and rough restrictions about usage.

One of the factors behind USA's great strength and world dominance after WWII is precisely the tradition of practical thinking, pragmatism and effectiveness, and not letting theoretical objections be a hindrance, but rather "act first and tidy up afterwards". In this way, they had "tidied up" after the damaging effects from *ionizing* radiation – like from X-rays and radiation from materials for atomic bomb development – had been demonstrated and better understood through a number of grim, but practical experiments.²⁷²

It was during and after World War II that the development of technology and knowledge really gained momentum. Some suffered *burn injuries* from repairing radars and radio transmitters. There were cases where factory workers or assemblers simply had parts of their bodies boiled or fried, as we now all know can be caused by a microwave oven.²⁷³ In addition, terms such as *radarman's disease* and *radioman's disease* came into use as labels for "diffuse" health problems – headaches, insomnia, fatigue, etc. – as they were found typical of these professions. From medical professionals, the reports piled up at the very beginning of the 1950s about such diffuse symptoms in work places where work was carried out with microwaves, but also more specific injuries, e.g., cataracts, were reported.^{274,275}

Of course, something had to be done. Some employers introduced practical exposure limits to prevent employees from being injured on the job. In 1953, the telephone company Bell introduced an exposure limit of 1,000 $\mu\text{W}/\text{m}^2$ due to proven eye damage. Several large players, e.g., major radar manufacturers and military units, introduced their own exposure limits in-house. But it could not continue like this: Not only did employers face lawsuits from workers whose health had been damaged, but it meant unrest in the workplace, skewed competition, and uncertainties that were unbearable for any of the parties – employers, authorities and employees alike. Moreover, employers feared that the authorities might set unreasonably strict limits hindering their business, or put restrictions on the development of new radars and weapons systems. This was in the early postwar period. All were optimists and all feared the communists behind the Iron Curtain. The US

272 E.g. the dosimeter was invented in the USA as early as 1907, but it was not until the Manhattan Project during the Second World War that radiation protection developed.

273 Brodeur 1977 reports several such cases.

274 Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

275 See also Flydal, E: My cataract, Milton Zaret's death, and Jon Fredrik Baksaas' retirement job, blog post, 02/08/2015, <https://einarflydal.com/?s=grå+stær>

pursued its policy of “containment” (encirclement of the Soviet Union and the Eastern Block), and needed long-range radars and communications.

Among those having significant problems, was the Navy. They got ever more radio communication equipment and radars set up on decks, at short distance to the crew.

The biophysicist Herman P. Schwan (1915 – 2005), a German radiation researcher who was taken over to the USA as part of the Operation Paperclip after WWII, is considered the founder of biomedical engineering in the United States. In 1953, he proposed to the US Navy that it should set a limit for short-term exposure from radars, radios etc., to avoid burns from thermal radiation: $100,000,000 \mu\text{W}/\text{m}^2$ (micro-Watts per square metre) at a frequency around 1 GHz.²⁷⁶ This was intended as a practical limit that would prevent *acute heating damage* from radio frequency, i.e. *non-ionizing* radiation.

This was what the Armed Forces needed above all – protection against *acute* injuries. That so called “non-ionizing” electromagnetic fields could initiate processes that lead to the breaking of molecular bonds, e.g., by pulsing (modulation of the signal) or by indirectly triggering biochemical processes which led to ionization, was then disregarded.

In 1955, Schwan proposed this limit as a sort of compromise proposal at one of the many microwave conferences that took place at the time, and where the discussion between medics, the armed forces, industry and research had stalled:

“Controversial discussions took place about the transferability of results from animal experiments to humans, experiments in which cataracts, changes in the gonads [testicles and ovaries], disturbances in the central nervous system, etc. had been found. Neither did differences about the inexplicability of symptoms such as headaches, changes in the blood count, visual disturbances, lack of concentration, radar beam hearing, memory loss in humans, etc. with low power density, lead to any agreement.”²⁷⁷

Schwan's professional argument behind the proposal was that the laws of physics supported it and that the exposure limit could be determined based on physical heat theory: The exposure limit was set based on what is needed for microwave radiation to create heat by causing water molecules to undergo strong oscillations – as in a microwave oven.

The thinking was that since “non-ionizing” radiation cannot, by definition, knock electrons out of orbit and thus break molecular bonds, it follows that such radiation could not damage in any other way than by heating, that is by causing molecules to shake vigorously, so vigorously that the tissue is shaken to pieces (burning). So, put simply; if you are protected against heating, you are, according to such physics, protected against all damage from “non-ionizing” radiation exposure.

This exposure limit was agreed upon as a compromise – for working life, that is for healthy and fit adults of working age. But Schwan himself argued the exposure should last a maximum of one hour, not at all around the clock.

Herman Schwan published more than 300 scientific papers as a biomedical engineer and biophysicist, and was fully aware that biological effects also occurred at exposure levels that were too weak to cause heating. He eventually argued intensely that the limits were too broad – since the heating criterion did not take into account other forms of damage that worked with much weaker exposure. Hence, he was completely clear that there were harmful biological effects at much lower exposure levels.

²⁷⁶ Hecht, K. "The value of the limits for mobile phone radiation", Competence Initiative e.V., 2009, <https://kompetenzinitiative.com/der-wert-der-grenzwerte-fuer-handystrahlungen/>

²⁷⁷ Ibid.

But this was as far as he got: Defence and industry had been given a simple principle that gave them a lot of freedom and a kind of scientific justification. They were no longer interested.²⁷⁸

According to several sources²⁷⁹, discussions on *non-thermal effects* dominated "numerous scientific conferences between 1960 and 1980, both in the United States and elsewhere." The objections to setting exposure limits restricted to just thermal heating were reflected in the minutes from a large number of conferences in the USA.²⁸⁰

However, at this stage research and knowledge no longer helped. The strong party, the defence and the industry, had got their principle and they stuck to it going forward.

For the general population, the limit was therefore – in accordance with common safety thinking – set at one tenth of the limit set for working life conditions, i.e. at $10,000,000 \mu W/m^2$.

7.3 The simple rebuttals – and the arguments against them

There was no lack of observations – also within the US Defence itself – demonstrating that such a criterion – the thermal – did not meet the requirements for adequate radiation protection: Helicopter pilots' children were too often born with club-foot, the pilots themselves got an increased risk of cancer, radio operators got "radioman's disease", radar repairmen got early cataracts, etc., etc.. None of them had heat injuries. Some cases went to the courts.

Some scientists referred to research from both the USA and Europe, West and East, and tried to convince authorities and industry to think better. But everything and anything from the East Block was *per se* suspect in the McCarthy and Cold War era. The US Defense Forces, which had themselves done extensive research on microwaves, had archives of thousands of documents, both from American and Soviet research, documenting health damages so there was no lack of source material.

It might seem the thermal paradigm got its foothold simply by being put in use and in the form of a standard (1966). You wouldn't believe it could be wrong, since that principle was used by authorities and defence. – Had it been wrong, they wouldn't have used it, would they? – Any opposition could be met with a "So, you don't trust the authorities, do you?" The thermal dogma became a kind of "too big to fail" as the forces behind it were "too powerful to be wrong".

It didn't even help with completely obvious evidence from everyday life. E.g. The Electric Company had to recall 90,000 TV sets because they radiated too much so people got sick from them.²⁸¹ They were not burnt or cooked. That wouldn't happen if the heating-based limit really gave the protection the defenders claimed it would.

For the United States' Defense, defending the thermal paradigm gradually became a kind of two-sided operation, a two-front war, characterised by a mixture of tactics and ignorance:

The US Defense had to defend externally and in many situations internally, that one could not be injured by non-thermal exposure and that no other damage mechanisms had been demonstrated, because this was inherent in the limit value itself. Otherwise, it would have been wrongly set!

At the same time, the defence experts used just such low exposure levels in their weapons development. Also, as part of the so-called *Pandora case*, the US intelligence, defence and foreign

278 Hecht 2009 op. cit., see note 276

279 Hecht, K. "The value of the limits for mobile phone radiation", competence initiative e.V., 2009, Paul Brodeur: The Zapping of America, Norton & Co, N.Y., 1977, 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/>

280 Karl Hecht 2009 op. cit. note 276, lists a number of these conference proceedings.

281 Hecht 2009 op. cit., see note 277

services had to survey, realise and complain to the Soviet authorities that the US embassy staff in Moscow got ill as the embassy building was radiated for a total of 22 years – at exposure levels well below US guidelines, set to the "thermal level".²⁸²

Project Pandora was an extensive project to get the Soviet Russians stop irradiating the US Embassy in Moscow with rather weak, pulsed microwaves. The radiation had been going on for years and led to a number of cancer cases and other illnesses at the embassy. Three ambassadors got cancer, though the two of them after service in Moscow. The situation was very delicate: The harmful effects were surveyed with ever new medical teams. In the first place, such harmful effects should not have been possible according to the thermal paradigm as the exposure was too weak. One could not openly claim that the irradiation was harmful, since that would undermine the thermal paradigm. But at the same time, the US government had to get the Soviet Russians stop it – since it seemed so clearly to harmful.

At this time, the US's various defence branches also carried out extensive research and development of weapons that would be able to neutralise enemy soldiers by the use of microwaves weaker than the thermal level – i.e., without heating up. They did not want to undermine this work.

The Pandora project went on for many years, they attempted to keep it secret, and became entangled in a series of contradictions. At the same time, new military and other medical teams did their investigations and constantly learned about the harm electromagnetic exposure could cause.

The reason why the Soviet Russians initiated the irradiation was never fully clarified. One speculation is that Brezhnev wanted to send an invitation to the United States to cooperate on a global ban on microwave-based weapons systems.²⁸³

Also, as the Pandora project demonstrated both short and *long-term effects*, possible long-term effects from microwave radiation were something that the US Defense deliberately wanted to deny. The US Defense simply could not afford to take this into account. Protecting against acute effects or admitting possibilities for such effects, seemed not feasible, according to military statements cited by Brodeur,²⁸⁴ as it would lead to compensation cases and hamper the development of radars and weapons systems.

For such reasons, claiming thermally based limits did not measure up, was simply in the era of Cold War an attack on the West – an unpatriotic act. It was of little help to refer to Eastern European research in the spirit of the times: It could be ridiculed, careers could be destroyed and the advocates of stricter limits could be suspected of being disloyal to the West and its defence capabilities. Suspicion would be raised and the underlying motives sought for such opposition.

However, the evidence that significant harmful effects were found at "sub-thermal levels" was there anyway, in stacks of research reports. If one were to argue legitimately against all that research, the argument would necessarily have to be based either on;

- something must be *wrong* with all that research,
- that other and better conducted research did *not* find any connections, or
- that the health damage found was *so small and trivial* that it was *not in society's interest* to take it into account.

282 The Pandora case is described in several books, i.a. Schjelderup, Vilhelm: Electromagnetism and life – a confrontation between two superpowers of science, 1987 and Brodeur, op. cit., see note 144

283 Vilhelm Schjelderup: Electromagnetism and life: a confrontation between two superpowers of science, Dreyers forlag, Oslo, 1987; Brodeur op. cit., see note 144

284 Brodeur op.cit., see note 144

With a financial stranglehold on research environments, there were also opportunities to have research carried out that would *not find anything*, or simply to stop the projects that made discoveries. We shall return to that.

Brodeur and other sources document a number of projects that made discoveries of long-term effects that were simply terminated when conclusions were undesirable. Such researchers were not given new assignments. In the first decades after World War II until the 1980s, 60% to 80% of the total scientific research in the USA was carried out on military contracts. For the universities, defence was a very important source of income. Other jobs were largely unobtainable for the kind of specialists working on radiation and biological effects. The alternatives to compliance were thus pretty poor.

The research results could not be criticised on objective grounds, but they could be doubted, overlooked or simply terminated. And one could initiate "counter-research".

As a new norm takes hold, it becomes its own reality: Hence, if researchers found harmful effects from exposures too weak to produce heat, they simply had to be wrong, as such an effect could not be possible!^{285,286}

You don't have to look long in engineering reports before you find such circular reasoning: For the engineer, the exposure limits are just a reference you take for granted and compare measurements to, without questioning its scientific basis. This is reflected here in Norway, for example in NKOM's technical measurements of AMS/smart meters:²⁸⁷ NKOM, which is not assigned the task of evaluating health risk, takes it for granted that levels lower than the limits mean that no damage to health can occur, and conclude accordingly – i.e. making statements about health risk.

Thus a reality with its own logic was created with the solidification of "the thermal paradigm". This logic also penetrated public administration through industry's influence:

In the USA, it is traditional for both ambassadorial titles and positions at the top of the central administration to be awarded to people who have made large donations to the election campaign of the winning presidential candidate. E.g., the last three heads of the FCC, the Federal Commission of Communication, have come from the telecoms industry and made large contributions to the incoming president's election fund.²⁸⁸ This way, industry's influence has generally been very large, so large that a recent analysis from Harvard describes that civil service agency as "captured".²⁸⁹

Therefore, it was only after strong pressure in 1971 from a number of doctors and scientists that central authorities in the USA published a report which, under the title "*Program for Control of Electromagnetic Pollution of the Environment*", had been written by experts appointed by the U.S.

285 Elements of such thinking can be found in FHI report 2012:3, which is an important basis for Norwegian radiation protection policy.

286 Paul Brodeur: *The Zapping of America*, Norton & Co, N.Y., 1977, and Don Maisch: *The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation*, PhD dissertation, Univ. of Wollongong, 2010, <http://www.emfacts.com/the-procrustean-approach/>

287 See e.g. Advanced measurement and control systems Measurement of transmission patterns and EMF exposure, NKOM (Norway's National Communications Authority), January 2018, https://www.nkom.no/fysiske-nett-og-infrastruktur/elektromagnetisk-straling/_attachment/download/e2080144-5414-455b-8c8e-add667c6ac5a:ce2b3f4e8b5973662d20692f3d04cb55ebc060d3/Avanserte%20m%C3%A5le-%20og%20styringssystemer%20-%20m%C3%A5ling%20av%20eksponering%20og%20sendetid.pdf

288 Tom Wheeler, head of the FCC during Obama's term, was for a generation the leader of the mobile industry's interest organisation, and had given US\$ 600,000 to the election campaign.

289 Alster, N. (2015): *Captured Agency, How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates*, Edmond J. Safra Center for Ethics, Harvard University, 2015, http://ethics.harvard.edu/files/center-for-ethics/files/capturedagency_alster.pdf

Office of Telecommunications Policy (OTP) in 1968. The report proposed specific measures to avoid serious adverse health effects from microwave radiation.²⁹⁰

This expert report revealed the extent of the environmental risk associated with the growing use of microwaves from communication technology and in technical use in factories that has been scarcely known before. Some quotes from the report speak for themselves:

“The electromagnetic radiations emanating from radar, television, communication systems, microwave ovens, industrial heat treatment systems, medical diathermy devices, and many other sources permeate the modern environment, both civilian and military. This type of man-made radiation exposure has no counterpart in man’s evolutionary background; it was relatively negligible prior to World War II.”

After describing the increasing number of radiation sources since 1940, the year before World War II began for the United States, the report very clearly warns of health threats:

“Power levels in and around US cities, airports, military installations and tracking centers, ships and pleasure craft, industry and homes may already be biologically significant. [...] Unless adequate monitoring and control based on a fundamental understanding of biological effects are instituted in the near future, in the decades ahead, man may enter an era of energy pollution of the environment comparable to the chemical pollution of today. [...] Thus, the consequences of undervaluing or misjudging the biological effects of long-term, low level exposure could become a critical problem for public health, especially if genetic effects are involved.” [Based on quotes in Brodeur 1977, p.14]

The experts behind this report seem to be fully in line with both the scientists of the time in the Soviet Union and the rest of the Eastern Bloc as well as with leading scientists in the West at the time. They also seem to be in line with today’s leading scientists who warn against pulsed microwave radiation in general, and particularly against AMS/smart meters and 5G (see Chapters 4 and 5).

Perhaps it was typical of its time that this report came just then, as it was an era of environmental awakening:

Rachel Carson's book "Silent Spring" was published in 1962. It was about how the environmental toxin DDT, which everyone used both on houseplants, in agriculture and directly on own skin, accumulated up the food chain all the way to the top and killed eagles. The book accelerated a dormant environmental movement and suddenly gave most people an awareness of the environment and the dangers that loomed in a technology-driven society. The consumer activist Ralph Nader had long since come out against the car industry, which opposed seat belts and other safety measures.²⁹¹ The student revolt, which in the USA was largely directed against the large concentrations of power in the military and the business world, the so-called military-industrial complex, came in 1968.

Researchers and health workers joined with lung cancer patients and lawyers campaigning against the tobacco industry. Others protested against the use of asbestos, lead and PCBs. The first Earth Day was celebrated in 1970. The nuclear power debate was at its peak in the 1970s. Love Canal, the story of a housing estate built on a chemical landfill that caused health problems, emerged in 1976. The accident at the Three Mile Island nuclear power plant happened in 1979, with 2 million people affected. We who studied social studies at the time, read Garratt Hardin's article from 1968 on "The

290 Brodeur 1977, note 144, reproduced in Hecht 2009 op cit. p 28, see note 68, *Program for Control of Electromagnetic Pollution of the Environment* report available from: https://books.google.co.uk/books?id=bsRIAQAAIAAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

291 Nader, Ralph: *Unsafe at Any Speed*, 1965

Tragedy of the Commons"²⁹² on how common goods – such as air, water and untouched nature – are not taken care of because no one takes on the responsibility for taking care of these common resources, while the many are interested in exploiting them.

Now this wave of environmental concern had led to a public proposal of a plan to stop “*electro-fog*” – the environmental pollution from electromagnetic fields.

But so didn't happen.²⁹³

“It appears that opposition from business and military sectors prevented this government report from being implemented.” [Brodeur 1977]. “The current generation of electromagnetic field researchers do not even know about this report. The further development of EMF research in the United States has been determined by those researchers who apparently could not find any harmful effects of electromagnetic fields. As in Germany, these American researchers also tend to be ignorant of and deny that non-thermal effects exist.” [Becker 1994].²⁹⁴

A little search shows that the report from 1971 must have been part of a series of reports that followed in the years to come. All of them, judging by the key words, seem to address the “thermal paradigm”. All were stopped, it seems. None of them are available.²⁹⁵

In 1971, when the report was written, an exposure level of 10 $\mu\text{W}/\text{m}^2$ was commonplace in US cities. This was the level the experts behind the report were concerned about. Today, many times this level of exposure is commonplace in urban public spaces.

At the main railway station in Stockholm, total exposure from various microwave sources has been measured at up to more than 150,000 $\mu\text{W}/\text{m}^2$.²⁹⁶ In Swedish schools, a pregnant teacher can work a full day under a WiFi router producing strong pulsations and an exposure at around 100 $\mu\text{W}/\text{m}^2$.

Quite in line with Hecht's descriptions of the findings in Soviet Russian research, the morbidity picture in the USA and several other countries during the same period has changed so that diseases linked to oxidative stress, a typical reaction to environmental toxins – including electromagnetic fields, now account for a very large and rising proportion of morbidity.²⁹⁷ This could of course be a coincidence. However, such effects cannot be conclusively confirmed, as science does not have methods for doing so. So, should we then dismiss such effects as sheer speculation, or check if a causal link is reasonable?

292 Garrett Hardin: The Tragedy of the Commons, Science, 13 Dec 1968: Vol. 162, Issue 3859, pp. 1243-1248, DOI: 10.1126/science.162.3859.1243, <http://science.sciencemag.org/content/162/3859/1243.full>

293 Hecht op. cit., see note 68

294 Hecht op. cit., see note 68

295 U.S. Department of Energy, Office of Scientific and Technical Information, <https://www.osti.gov/biblio/7114234-program-control-electromagnetic-pollution-environment-assessment-biological-hazards-nonionizing-electromagnetic-radiation-annual-report-jan-dec> [Added 2023: Nicholas Steneck (The microwave debate, MIT Press, 1998) tells the US Congress terminated the financing of the follow-up work to be done by EPA, the US Environmental Protection Agency.]

296 Lennart Hardell, Tarmo Koppel, Michael Carlberg, Mikko Ahonen and Lena Hedendahl: Radiofrequency radiation at Stockholm Central Railway Station in Sweden and some medical aspects on public exposure to RF fields, International Journal Of Oncology 49: 1315-1324, 2016, DOI: 10.3892/ijo.2016.3657

297 Richard Lear: A New Era of Chronic Disease in America and what's behind it, August 2017, ResearchGate, <https://www.researchgate.net/publication/319288113>

7.4 The 1980s: the backlash against the precautionary principle

In the USA, the 1970s brought a spate of scientific research into environmental damage. Also, environmental and health legislation was developed with a corresponding spate of new government offices, regulations and other controls.²⁹⁸

The 1970s were also the years when the *precautionary principle* was introduced into legislation. The breakthrough for precautionary thinking in the 1970s in US policy and legislation resulted in a period in which various industries were accused of environmental pollution or activities harmful to health. The same also happened in Europe.

But nothing could shake the thermal paradigm. The forces were too strong. In many ways, that case was not at all about what was true or false, right or wrong as far as to the findings. Don Maisch describes in his PhD thesis that establishing the thermal paradigm was fundamentally not a scientific, but a *political process*, governed by the interests of the American Defence and by the needs of industry.²⁹⁹

It was a process that set free social, business and welfare development through radio communication as a consumer technology. In this context, research and research results seemed to be merely a tool that could be drawn upon and used when suitable. Research ethics – "to be guided by the search for truth" – belonged in universities, not in politics, Defence or the business world. Rather, it was The Law of The Jungle that applied. It applied to the arms race between countries and in the competition for defence contracts.

However the thermal paradigm had been established. Ensuring that it was maintained and defended was an activity that fitted in well as times shifted in the early 1980s.

In the 1980s, industry struck back. Environment friendly laws were lobbied against and doubts were cast about the research underpinning it. A countermeasure from industry and research side was also to develop a particular blend of market liberalism and *risk analysis*, a quantitative subject, to take care also of topics which defy quantification.³⁰⁰ Strict criteria were developed for what evidence was needed before research had to be taken into account: Restrictions should not to be introduced without clear proofs that the specific industrial activity in question was harmful.³⁰¹

Using risk analysis as a tool, meant one should be able to assess and even quantify the probability of accidents, thus analyse the technology more systematically and to a greater extent than had been done before. Environmental accidents had shown the need. Risk analysis would provide improvements and legitimacy, becoming a prerequisite for embarking on new and large projects.

But everything can be exaggerated. Risk analysis also provides a false sense of security: Risk analysis for nuclear power plants even includes numerical estimates of the probability that misunderstandings in oral communication will arise between workers at the power plant.³⁰² As if

298 Paul F. Deisler, Jr. Richard C. Schwing: History Of The Society For Risk Analysis Through The Year 2000, <https://www.yumpu.com/en/document/view/46330345/history-of-the-society-for-risk-analysis-through-the-year-2000/122>

299 Maisch, Don: The Procrustean Approach, Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, PhD-avhandling, Univ. of Wollongong, 2010, <http://www.emfacts.com/the-procrustean-approach/>

300 Paul F. Deisler, Jr. Richard C. Schwing: History Of The Society For Risk Analysis Through The Year 2000, <https://www.yumpu.com/en/document/view/46330345/history-of-the-society-for-risk-analysis-through-the-year-2000/122>

301 Sheldon Rampton og John Stauber: "Trust Us We're Experts: How Industry Manipulates Science and Gambles with Your Future", 2008; and Erik M. Conway and Naomi Oreskes: Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, 2012.

302 (The source is currently unavailable. It can be found referenced in Flydal, E: Oljespråk [the Language of Oil], Universitetsforlaget [University Press], 1993)

such numerical estimates can be meaningful for calculations of risk! Risk analysis gave the impression of exact knowledge: You are impressed and feel assured when you get thick reports with quantifications with two or even more decimal, although no way of controlling their validity.

This is also the case with stringent research methods: They may raise the quality of decision-making by improving their basis and knowledge, or they may be used to give the appearance of infallibility and quality.

The tobacco industry was an early adopter of PR agencies in the fight to preserve its revenues. The PR agencies created strategies and plans for how to counter science not wished and how to maintain, and preferably increase, the industry's position by setting high demands for evidence to be accepted.

That story has been described several other places, also in the form of quotes from the industry's internal strategy documents.³⁰³

It would appear that the wireless industry followed – and still follows – pretty much the same recipe. We find this way of thinking – transformed into specific process requirements – at ICNIRP, the organisation that develops the guidelines resulting in today's limits in Norway and a large number of other countries.

But we will have to come back to that after looking more at how the radiation protection network is organised.

303 For example: Clive Bates and Andy Rowell: Tobacco Explained - The truth about the tobacco industry ...in its own words, Action on Smoking and health (ASH), <https://escholarship.org/uc/item/9fp6566b>

8. ICNIRP's guidelines and how they are handled

The first ICNIRP's guidelines for both low-frequency and high-frequency electromagnetic fields were published in 1998. A revision, which is under consultation at the time of writing (summer 2018), remains based on the thermal paradigm, dealing with the health hazard of acute heating only. [The revision appeared in spring 2020 as the ICNIRP 2020 guidelines.] The consultation document denies there is sufficient evidence for harmful effects from weaker exposure.³⁰⁴

The ICNIRP guidelines from 1998 should be regarded as a step in the development of Western, i.e., US-dominated, standards, shaped in step with technological development. By and large, the USA's strong engineering organisation the IEEE develops technical standards for wireless communication, and then Western Europe follows with some lesser modifications.³⁰⁵

In the radio frequency (RF) range, which is the *high-frequency* part of the spectrum, hazard is expressed in terms of *exposure intensity thresholds* which are calculated based on the given frequency's ability to *create heating of water in cells*. From these energy intensity thresholds, *reference values* for the establishment of *recommendable exposure limits* are set.

Within the area of *low and extra low frequencies*, the danger limits are set at the energy intensity thresholds above which signalling along nerve pathways is triggered, e.g., with some form of hallucinations or sensations as result.

Different frequencies have different penetration capabilities in biological tissue. The energy in the radiation that does not penetrate, is absorbed. Roughly speaking, it has traditionally been assumed that higher frequencies have poorer penetration in human tissue, and that when such high frequencies result in wavelengths that are just a millimetre long – somewhere up in the Gigahertz range, the waves have such a low penetration capacity that they stop, i.e., absorbed at the skin's outermost layers. The guidelines' recommendations thus vary according to the frequency's calculated biological impact. (If you read about *Brillouin precursors* earlier in this text, you know that this assumption is not correct.)

According to the guidelines, exposure values must be measured as *average values over time over a measurement area*. In the high-frequency part of the frequency spectrum (which includes the microwave range), heating of 1 degree Celsius in 6 minutes on average over an area of 1m² is considered the hazard limit, after a reduction factor has been applied for safety reasons, i.e., down from the identified energy intensity threshold.

The power density ("strength") required to reach the exposure limit thus varies with the frequency, and does so mainly in such a way that the exposure intensity limit must be reduced from 10,000,000 $\mu\text{W}/\text{m}^2$ at the frequency normally used as example, 1 GHz, down to some lower limit for the frequencies specified in the Free Use Regulations at which, for example; the AMS/smart meters operate.

The recommended reference value for AMS/smart meters will therefore be lower than 10,000,000 $\mu\text{W}/\text{m}^2$. However, such details have no practical significance in this document, as there is no doubt that the AMS meters under all normal conditions create exposures well below these limits. We may therefore – for the sake of simplicity – stick to the value used in the graph and usually mentioned when exposure limits for the radio spectrum are given: 10 million $\mu\text{W}/\text{m}^2$, while remembering that this is actually too high in the context of AMS/smart meters.

304 ICNIRP 1998 guidelines: see footnote 5. The hearing: see [einarflydal.com 31.07.2018](http://einarflydal.com/31.07.2018)

305 GSM was a clear exception, where a European consortium was responsible for standard development. Norwegian expertise, above all a group from Televerket's research institute led by my good colleague Jan Arild Audestad, played a crucial role.

AMS/smart meters are thus regulated based on their *basic*, or *carrier*, *frequency*. At the same time, we have seen that such meters transmit low-frequency pulses that are well known to be biologically active and do so at relatively short intervals. Hence, one may ask whether, with regard to health risks, exposures should also have been regulated according to their low frequencies. It would for practical reasons be difficult to do, but raises the question of whether regulation based on the *carrier frequency only* can possibly be relevant.

8.1 ICNIRP's process for setting limits goes through the committees that define the "state of knowledge"

Basically, the guidelines from ICNIRP are proposals for guidelines that countries can choose to use or not for setting exposure limits. Through being referred to in various standards from the ILO, EU requirements, norms for electrical installations etc., ICNIRP's guidelines have been built into many different parts of national administration in many countries.

The limits that countries set based on ICNIRP's guidelines are based on ICNIRP's *reference values and calculation methods*. Reference values provide *a starting point for assessing where limits should be set*. They are calculated according to some principles and formulae based on more or less good assumptions or guesswork as to the factors causing biological damage. In this context it is, as mentioned, heating. Heating occurs when the energy in the radiation sets molecules in vibration. The method of calculation is therefore a method of calculating how much energy is needed at different frequencies to produce a vibration that is harmful – that is to say, *unfavourable thermal effects*.

To set limits which cater for more than just the reference values to protect against overheating, provided in ICNIRP guidelines, you may follow ICNIRP's recommendations on, and *requirements for, evidence* (scientific evidence) *on biological effects*. They are in a separate policy document.³⁰⁶

As follows, ICNIRP's guidelines do not provide limits, but only *proposals for reference values*, i.e., a proposal as a starting point for *determining exposure limits*. The ICNIRP 1998 guidelines also limit themselves to providing reference values to prevent damages from *acute tissue heating*. In the guidelines, it is emphasised that in order to protect against effects other than acute heating, including damage that may occur after long-term weaker exposure, *countries and employers themselves must set limits based on what is the state of knowledge at any given time*.

The ICNIRP standards relevant for AMS/smart meters,³⁰⁷ are thus based on "the thermal paradigm", and – in the same way as IEEE's standards – do only provide reference values to protect against health damage from acute heating. Rightly, a significant safety margin, standard in toxicology, has been added, one for working life and then one for the general population – but still only *in relation to acute heating and only based on measuring received and absorbed power, or energy density*.

ICNIRP (1998) states open and clearly that the guidelines do not apply with regard to other damage mechanisms that might act acutely. Also, nor do they apply with regard to protecting against the possibility of damage or health problems from longer-term exposure, although such effects have so far not been established, according to ICNIRP.

306 ICNIRP Statement – General approach to protection against non-ionizing radiation protection, Health Physics 82(4):540-548; 2002. In this document, the Hill criteria and WHO criteria to identify causality are suggested.

307 ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300GHz), Health Physics 74(4):494-522; 1998.

Revision of the part that applies to low-frequency fields:

ICNIRP Guidelines For Limiting Exposure To Time-Varying Electric And Magnetic Fields (1 Hz – 100kHz), Health Physics 99(6):818-836; 2010, DOI: 10.1097/HP.0b013e3181f06c86

WHO's office with responsibility for radiation policies, "The International EMF Project", repeats this view in its material.

Accordingly, ICNIRP's relevant guidelines for exposure from microwave radiation do simply not apply to any of the damage mechanisms found relevant by all the research material in this document.

Protection against all such non-thermal effects is left to national authorities and employers to assess and to introduce limits that address such effects if found. ICNIRP suggests one should conduct an assessment and evaluation process ahead of setting such exposure limits, for which guidance is provided. As we have seen, ICNIRP and its members often participate in such processes.

The question of where the limits should be set is thus transferred to literature and evaluation committees, providing recommendations to national authorities.

Such *knowledge reviews* thus play a very important role, and are – in principle but seemingly not in practice – a correspondingly important arena for battles of interests between stakeholders, as opposition seems excluded from the very beginning. Through such reviews, the limit of 10,000,000 $\mu\text{W}/\text{m}^2$ is confirmed over and over again, and the thermal paradigm stands out as plausible due to the repeated confirmations that “no health risks have been found” at lower exposure intensities.

8.2 The reviews impose the burden of proof on the wrong party

According to normal scientific theory, the proponents of the "thermal paradigm" have the challenger role: They are the ones who should be able to explain how they can possibly claim the vast majority of studies are wrong, and also how they justify imposing demands for proofs so high they cannot be met in real life within medical and biological studies. They are the ones with the burden of proof.

ICNIRP 2002³⁰⁸ sets out assessment criteria that committees are recommended to use when assessing whether research results warrant stricter (or more lax) exposure limits. At first sight, these criteria seem sound, reasonable and thoroughly crafted. However, within such a framework, *the studies which do find non-thermal effects, carry the burden of proof, instead of the other way around. Also, the quality of these studies will be judged to be inadequate – by a committee recruited from the physics oriented ICNIRP, or with ICNIRP members in key positions, requiring extremely rigid standards for scientific evidence.*

With such a backdrop, it follows by itself that if errors are found that could be used to disqualify research results indicating the need for more strict limits, the assessment will be that the ICNIRP's reference values to protect against thermal effects, should remain unchanged, as no other effects have been proven. Hence, the reference values to protect against thermal hazards should be used as general exposure limits against any health effects – despite these reference values having no real scientific basis and since long proven insufficient.

By virtue of its institutional weight, ICNIRP manages to reverse the burden of proof as to what the state of knowledge in the field would indicate:

The limits should have been set based on the real knowledge status – the knowledge status that constitutes the bulk of the scientific research (see Figure 3). And then, if necessary, the knowledge base should have been put under debate, with any other basis for setting exposure limits being investigated and tested.

308 ICNIRP Statement – General approach to protection against non-ionizing radiation protection, Health Physics 82(4):540-548; 2002

An objection to this view could be, for example, that there are so many different mechanisms in play that it would be impossible to set any limits once non-thermal causes are accepted.

Biologist Martin L Pall has a rather practical and simple solution to this: The cell membrane's voltage gated calcium channels (VGCCs) appear to be one of the most sensitive – and one of the most harmful – pathways into the body, operating at the individual cell level. Any radio communication solution should therefore be tested based on whether it opens the voltage-gated calcium channels. One doesn't even need to know how radiation opens such channels, and one could perhaps even free oneself from the measurement parameter, *energy density*, which is a parameter reflecting a particular and very misleading assumption about what it takes to cause harm:³⁰⁹

“Biological optimization should be done by studying cells in culture that have high densities of various types of VGCCs, measuring such effects as increases in $[Ca^{2+}]_i$ and increases in nitric oxide (NO) production following EMF exposures. Such cell culture-based assessment of biological damage should allow progressive improvement of wireless communication devices and various other electronic devices by choosing designs that lower biological responses.”

Setting up such a test facility would cost a small fortune, but it could be done. Such a test facility would confirm that the thermal paradigm is not tenable. So it will not be done by the industry. Others will have to do it.

RESEARCH

To develop a solid base of scientific evidence regarding the potential health risks of exposure to EMF, the International EMF Project:

- Evaluates the scientific literature
- Identifies gaps in knowledge requiring further research
- Promotes a research agenda for researchers and funding agencies, focusing on the potential long-term health effects of mobile phone use, and on the possible link between childhood leukaemia and exposure to magnetic fields from electric power

INFORMATION

To facilitate dialogue between stakeholders by providing clear and unbiased information about the current scientific knowledge, the International EMF Project:

- Offers web-based access to a wide range of information resources
- Provides a database for researchers on current EMF research projects
- Convenes meetings on cutting-edge topics

STANDARDS

To help countries set their national EMF legislation and regulations, and to promote the same high level of health protection to all people, the International EMF Project:

- Provides a unique database of EMF exposure standards worldwide
- Offers model legislation to protect against EMF exposure
- Encourages harmonization of EMF standards

KNOWLEDGE

No major public health risks have emerged from several decades of EMF research, but uncertainties remain.

The challenges...

- There is no clear understanding if and how EMF, at the low levels emitted by common appliances, might cause damage to cells
- If a common EMF exposure were found to cause a disease, it would likely be a rare one. Demonstrating such a relationship would require complex population studies
- New EMF emitting technologies are constantly being introduced on the market, resulting in different types of exposure

The way forward...

A global research effort is key to clarifying health risks. This will enable public policies that protect human health while allowing technological progress.

WHO'S INTERNATIONAL EMF PROJECT STRATEGY FOR DEALING WITH EMF RISK

Figure 36: Leaflet for WHO's The International EMF Project: "No major health risks have been uncovered after many decades of research on EMF"

The policy guideline itself, ICNIRP 2002, states that these assessment criteria must *ensure that limits are not set irrationally or due to a lack of knowledge.*³¹⁰ No one can possibly disagree with such a point. Still, ICNIRP automatically labels any opposition to ICNIRP's guidelines as being based on fear and superstition rather than on facts and solid research, stating that the ICNIRP's own

309 Pall, Martin L: How to Approach the Challenge of Minimizing Non-Thermal Health Effects of Microwave Radiation from Electrical Devices, International Journal of Innovative Research in Engineering & Management (IJIREM), ISSN: 2350-0557, Volume-2, Issue -5, September 2015

310 ICNIRP Statement – General approach to protection against non-ionizing radiation protection, Health Physics 82(4):540-548; 2002

guidelines are science based, rational and facts-based. This is just the kind of rhetoric that was used to defend business liberalism, as part of their arsenal during the 1980s when "The Empire" – the big corporations – “struck back” against environmentalist success in the decades behind.³¹¹

8.3 ICNIRP's relationship to the precautionary principle

We have seen what kind of relationship the "thermal paradigm" has to biological and medical research: In view of the warnings of future consequences from the scientists, it appears an act of ignorant and irresponsible health policy to set exposure limits based on this paradigm.

However, in a statement included in the aforementioned policy guidelines³¹², ICNIRP endorses the EU's *precautionary principle*. How should this be understood? Given the thermal paradigm as the foundation on which ICNIRP's guidelines are built, and all other mechanisms being systematically rejected, such an endorsement seems a contradiction in terms – as if ICNIRP tries to calm down a conflict with the EU. It is possible to understand it differently:

Alternative 1: “ICNIRP has already hailed the precautionary principle by introducing a substantial safety distance from the thermal threshold above which overheating occurs, to the much lower recommended exposure limits: down to a tenth for working life and a further fifth down for the general public.”

Alternative 2: “ICNIRP leaves countries and employers to determine the exposure limits. Hence, assessments of precautionary measures are left to committees, which in turn means that when such committees do find threatening clouds on the horizon, they are left the full freedom to recommend any precautionary stricter limits they see appropriate.”

Both of these interpretations might be true simultaneously:

In communication with the Norwegian Radiation Protection Authority, I have been served *Alternative 1*,³¹³ which shows how one might be strongly influenced by a specific mindset, not being able to see how fundamentally fragile such a view is to the validity of the thermal paradigm.

Alternative 2 is what is actually practised by the Norwegian Radiation Protection Authority, based on the (FHI-2012:3) knowledge review and similar reports: Since they find no established risks, a precautionary approach means adding safety margins for no reason!

With respect to *Alternative 2*, The Norwegian Radiation Protection Authority seems to follow the liberal market tradition established in the USA in the 1980s as a counter-reaction to the 1970s green offensive against the corporations. If so, it is remarkable that it has been allowed to uphold such a practice. Maybe this is the case as the activities of the Radiation Protection Agencies are so technical and foreign to both politicians and to other political and administrative entities, and so well protected by military stakeholders, that it has simply be left in peace with its thermal paradigm.

However, this is just speculation. The lack of a real precautionary policy can also be interpreted as the result of lack of competence and capacity in the administration. Or one could be even more outspoken, like a group of prominent German researchers accusing their country's central authorities of failing to learn from the lack of precautionary policies in the past:

311 Sheldon Rampton and John Stauber: "Trust Us We're Experts: How Industry Manipulates Science and Gambles with Your Future", 2008

312 ICNIRP Statement – General approach to protection against non-ionizing radiation protection, Health Physics 82(4):540-548; 2002

313 Personal message from Lars Klæboe, Norwegian Radiation Protection Authority.

“The German conditions [...] are the result of a significant number of lobbyists having penetrated and infiltrated health and environmental protection administrations within their key areas. We do not hesitate to call this a form of "institutional corruption", as Franz Adlkofer did at a symposium held at the Center for Ethics at Harvard Law School in Cambridge (USA).³¹⁴ In this form of corruption, money comes before health, in the authorities' self-interest giving this priority a legal basis that is difficult to break through. [...] The German telecommunications policy shows that in this field trial, involving 80 million people in Germany, the right to legal protection has been betrayed in favour of commercial interests.”

*Prof. Dr. Phil. K. Richter, Prof. Dr. med. K. Hecht,
Dr. med. M. Kern, Dr. med. H.-Chr. Scheiner*

8.4 National radiation protection expertise is being reduced

As previously explained, individual state governments decide on national exposure limits. However, in practice, several countries have so little of their own expertise on the matter, they just accept the committee knowledge status reports. Far less are they able to oversee or dissect these committees' ways of working.

The Norwegian Radiation Protection Authority has made it clear on several occasions that the agency does not have medical, biophysical or radiation medicine expertise in the field of “non-ionizing radiation”, and thus simply rubber-stamps the assessments coming in from ICNIRP and similar.³¹⁵

The Norwegian Radiation Protection Authority thus bases its administration and legislation in this area on knowledge reviews carried out by others, without the competence to check these reviews.

Norwegian health authorities, including the National Radiation Protection Agency, often refer to the committee report (FHI report 2012:3)³¹⁶ as their foundation for the Norwegian management of radiation protection for non-ionizing radiation. This report and the committee behind it are discussed together with other similar reports carried out for other authorities in a separate section below on committee assessments. A common feature is that they defend ICNIRP's reference values for protection against acute thermal damage on tissue as satisfactory exposure limits by claiming that there is no research reliable enough to dictate stricter limits – neither for acute, nor for long term effects.

In the Nordic region, the Swedish Radiation Protection Authority (SSM) has a standing committee on health effects from non-ionizing radiation. This committee functions as a kind of common Nordic reference point (see section 6.1), and its reports are frequently referred to in other countries. This committee consists exclusively of members who are, or have been, members of ICNIRP, or who have similar opinions as ICNIRP and the WHO International EMF Project. No wonder, they always reach the same conclusions.

The Nordic countries strive to have the same attitudes and identical radiation protection policies. Now and then they issue joint statements that are in the spirit of the ICNIRP about health hazards from non-ionizing radiation such as mobile phones, etc.³¹⁷

314 Adlkofer, Franz: Our protection against radiation is contrary to science, lecture at the Safra Center for Ethics, Harvard University, 2011, https://kompetenzinitiative.com/wp-content/uploads/2019/08/broschuerenreihe_heft-5_eng_screen.pdf

315 See figure 37

316 The Norwegian Health Directorate: Medical certificate and automatic current meters, 14.03.2018, <https://helsedirektoratet.no/nyheter/legeattest-og-automatiske-straummalarar>

317 Search online for "statement by the Nordic radiation safety authorities" and you will find them.

In Norway, ICNIRP's guidelines automatically become Norwegian regulations – untranslated. None of the other Nordic countries have a similar provision except for Iceland. It seems Norway strives to be the forerunner: After the revision in 2016, Norway even established in the national radiation protection regulations³¹⁸ that there is no reason for particular carefulness (i.e. to follow the ALARA principle), as long as the exposure is lower than "good practice" suggests. "Good practice" is defined in the very same regulations as exposure being below ICNIRP's reference exposure values – which means that the Norwegian Radiation Protection Authority finds protecting against acute heating damage only as satisfactory, since no other health hazards have been demonstrated.

In other words, “non-ionizing” radiation below reference exposure values set to protect against thermal heating, is exempt from health risks in Norway – per regulations.

When you have defined the problem this way – in concordance with Herman Schwan's compromise proposal to the US Marines in 1955 and later in the first US standard of 1966, believing it is still good enough – you obviously do not need staff in this area of work. In Denmark, there is no one left in the National Board of Health to deal with such matters, only an independent medical consultant (oncologist) on call. In the Norwegian Radiation Protection Authority, there seems to be less than one man year to cover activities within mobile communications, AMS and the like with no budget. In the Finnish radiation protection agency, which was once big on non-ionizing radiation with its own research department, there are hardly any staff left. (Other Nordic countries I have not checked.)

Thus, in practice, the committees are the real focus of decisions as to whether ICNIRP's reference values should be used directly as exposure limits, or tightened down the road – committees which we have previously seen consist of members overlapping both in terms of personnel and thought patterns. These committees refer to each other and build on each other upstream backwards to ICNIRP and the WHO, while they largely consist of current or former ICNIRP members, in part identical individuals.

Hence, in reality, the exposure limits are formally decided locally, at the national state level, as in Norway and many other countries, but in reality by the ICNIRP members themselves in environments they dominate and in which it would be inconceivable that dissenting views would prevail. A number of cases document such situations where “unwanted” objections, putting forward “inappropriate” research, have been prevented by the committees.³¹⁹

The ICNIRP members selected for such committee work, are themselves dominating these selection processes, which are non-transparent. In such ways, power and bias is maintained.

318 Regulations on radiation protection and use of radiation (radiation protection regulations), <https://lovdata.no/dokument/SF/forskrift/2016-12-16-1659?q=strålevernforskriften>

319 In Norway, there are such examples from “The Kvikke case” (a marine vessel with a cluster of cancer and deformed offspring) and from the committee behind the FHI-2012:3 report. Internationally, one example could be the case of researcher Kjell Hansson Mild's participation in an EU literature review where his articles were rejected as inappropriate. [Sources not available.]



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Our date
29.4.2015

**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


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Figure 37: Letter stating that the Norwegian Radiation Protection Authority does not have its own expertise on health risks from EMF, but converts ICNIRP's reference values unchanged into exposure limits and allows committee conclusions automatically to constitute "knowledge status".

(Content is translated from Norwegian and pasted into original.)

8.5 A number of ICNIRP countries set stricter limits

As we have seen in Figure 1, a number of countries – including several in the West – have set far lower limits for EMF than what we have in Norway. This applies to countries that otherwise follow both the WHO and ICNIRP guidelines. They do so by using the freedom for action that ICNIRP and the WHO explicitly instruct states to exploit: To carry out their own reviews of the present knowledge and set limits accordingly. Also, they introduce restrictions through other laws and regulations.

A rough count shows the following: Out of the UN's 193 member states, 72 are listed in the overview in the FHI report 2012-3.³²⁰ Of these, only 13 countries are listed as "following ICNIRP" or as "the authorities recommend following ICNIRP" – which is a very vague category as to how the ICNIRP's guidelines are implemented: The vast majority of these countries are listed as just "following ICNIRP", while several of those "following ICNIRP" have much stricter limits for certain frequencies or specific areas. In Norway, "following ICNIRP's guidelines" is regulated by law, which does not at all clarify which exposure levels norms should be set.

Some countries, such as France, Cyprus and India, are *de facto* moving away from the thermal paradigm by mandating strict exposure limitations in certain areas, without challenging it in radiation protection regulations, but rather making the restrictions part of other laws and regulations, such as acts part of the educational system (discussed below).

Some examples are briefly discussed below.

EU/EEA

Within the EU and EEA (European Economic Area) area, new provisions for working life have been in effect since the summer of 2017. They impose extensive responsibilities on the employer to secure workplaces against health-damaging exposure to electromagnetic fields.

The provisions are structured in such a way that they are based on ICNIRP's guidelines, which means that limits must be set based on the state of knowledge and "good practice" – which in turn points back to ICNIRP's recommendations, where limits to protect against health hazards from heating are stated.

However, employers (as well as manufacturers of goods) have full responsibility independently to take measures when they become aware of health risks linked to exposure.³²¹

The EU's directive may be perceived as a political instrument through which the EU implements the ICNIRP's guidelines from 1998, while at the same time creating openings for more restrictive policies in each individual country and in the EU/EEA area, as and when there is a political basis for doing so – which, of course, is in line with ICNIRP guidelines. The directive is therefore not in conflict with the thermal paradigm and does not create controversy in that regard. However, it opens up for such a conflict.

As an example, in accordance with the EU decree in France, rules have been laid down that apply to workers to protect them from risks from EMF. Similar rules have been introduced in a number of countries, including Norway. These rules include the following in the French version³²², among other things:

- It is forbidden to place employees in areas where EMF is expected to be above the set limits.
- All employers must assess the EMF hazard.

320 FHI report 2012-3, table 9.1, p 168, see note 8

321 Directive 2013/35/EU, which also applies in Norway through the EEA

322 Decree National No. 2016-1074

- Medical examinations must be carried out at workplaces where exposure above established limits has been detected or *where an unexpected health effect has been reported*.
- *Employers must provide employees with training as to the symptoms and consequences of EMF*
- *Employers must implement measures to reduce EMF exposure*
- *Employers must protect employees against EMF* (valid from 2017)
- Certain measures must be implemented for the protection of pregnant women

Although the starting point here are ICNIRP-based limits, these rules allow for adaptation to stricter rules after the detection (or risk) of effects from weaker exposure than heating.

A number of individual countries take measures implying that adhering only to the thermal paradigm is unacceptable. For example, the French authorities issue guidance on the use of mobile phones concerning the protection of children and young people, and on ways to limit exposure when using a mobile phone:³²³ It would not be necessary at all if ICNIRP's guideline values were offering satisfactory protection.

Since the autumn of 2018, French President Emmanuel Macron has fulfilled one of his promises from his electoral campaign: banning the use of mobile phones in schools.^{324,325} France has previously adopted a ban on wireless technology (WiFi) in French kindergartens with toddler sections, as well as other similar institutions where children under the age of three stay over time, as well as strict restrictions on the use of wireless networks in primary schools. The ban and restrictions on wireless technology/WiFi in nurseries and schools are based on the possible hazard of adverse health effects from wireless communication.³²⁶ A recommendation in the French educational acts already applies recommending cabling to be used instead of wireless.

In Belgium³²⁷, guidelines have been laid down to prohibit the use of Wi-Fi in kindergartens and schools. There are also rules for the sale of mobile phones to children, a ban on the marketing of mobile phones to children under the age of seven.

In Spain, several of the regional assemblies³²⁸ have decided to implement measures to reduce exposure to EMFs.³²⁹

Several other countries, cities and individual schools have made similar decisions.

In Israel, a series of parental actions against wireless networks in schools have created waves in public administration for a number of years. In 2016, the Supreme Court chose to refrain from a ban, but rather to give a strong admonition that wireless should only be used where a wired connection is not possible. In the big city of Haifa, the mayor ordered the removal of wireless networks in all schools.

In India, minimum distances for base stations to schools and hospitals have been introduced in several states.

323 <https://ehtrust.org/france-policy-recommendations-cell-phones-wireless-radiation-health/>

324 "No more mobile phones in schools and colleges at the start of the 2018 school year", announces Jean-Michel Blanquer, Le Monde, 10.12.2017, https://www.lemonde.fr/education/article/2017/12/10/plus-de-telephones-portables-dans-les-ecoles-et-colleges-a-la-rentree-2018-annonce-le-ministre-de-l-education-nationale_5227485_1473685.html

325 This and the following paragraphs are taken from Flydal, E: Electromagnetic radiation - are we gambling with our children's health? in Briseid, Ole (ed.): Critical views on the school, Z-forlag, Oslo, 2018.

326 Law n° 2015-136 of February 9, 2015 relating to sobriety, transparency, information and consultation regarding exposure to electromagnetic waves, <https://www.legifrance.gouv.fr/loda/id/LEGIARTI000030214116>

327 <https://ehtrust.org/belgium-policy-recommendations-cell-phones-wireless-radiation-health/>

328 <https://ehtrust.org/spain-policy-recommendations-cell-phones-wireless-radiation-health/>

329 See footnote 328.

In the UK, many wireless networks have been removed under pressure from parents. Articles about computer industry executives making sure kids go to schools without wireless networks appear in newspapers.

In January 2017, Cyprus decided to completely ban WiFi and wireless technology in all public kindergartens. Simultaneously, state authorities decided to stop all installation of wireless networks in primary schools, as well as to impose severe restrictions on the use of WiFi in schools where it was already installed: In practice, WiFi should only be used by the pupils in exceptional circumstances and only with the permission of the parents.³³⁰

8.6 How ICNIRP's guidelines fail in radiation protection

As to what is needed for effective radiation protection, a number of weaknesses in ICNIRP's guidelines are summarised below.

ICNIRP's guideline values for the radio frequency range

- *only aim to protect against acute damage from short-term exposure, even if there is overwhelmingly solid evidence of damage appearing over time – whether as a result of short-term or long-term exposure.*
- *is based only on heating as the cause of damage, even though damage is overwhelmingly solidly shown to occur in other ways, and also from exposures too weak to cause heating.*

ICNIRP guidelines

- *take for granted that there must exist a positive dose-response relationship between effect density and symptom. Such a presupposition is an unrealistic restriction.*
- *prescribe a calculation method based on average exposure values over time so that short exposures, e.g. short pulses, that may be very strong, having a well known biological effect, will not register in the measurements.*
- *prescribe a process for taking long-term effects and other causes of harm into account through committee reviews, which link, in practice, through the assessment criteria suggested and the recruitment method practised, to the above mentioned thermal paradigm and measurement methods (dosimetry), thereby turning the burden of proof around.*
- *assign such assessment criteria to committee reviews that they are in practice conservative, hindering an evidence based, precautionary radiation protection.*
- *cause, through their acquired authority, radiation protection administrations in several countries to reduce their competence and capacity, trusting the “thermal dogma”, once set only a practical compromise without any credible scientific basis.*

ICNIRP's members

- *have high legitimacy through their ICNIRP association, but in reality constitute a small network of experts appearing repeatedly and in overlapping positions along the “exposure values delivery chain”.*
- *are scientists defending the thermal paradigm, recruited in ways not transparent, taking part in such processes as described, not by virtue of professional foundation but have by virtue of network building.*

330 <http://www.sbwire.com/press-releases/cyprus-removes-wi-fi-from-kindergartens-and-halts-wireless-deployment-into-public-elementary-schools-778002.htm> And: <https://ehtrust.org/policy/international-policy-actions-on-wireless/>

- *are part of a high impact environment constituting a bulwark to protect and spread lax exposure limits, consisting of scientists as well as business and defence lobbyists.*

The established bodies with authority enough to define “reality”, may simply dismiss or reject reports of showing health damages in line with the lion’s share of scientific research: They may simply declare even well-documented findings they themselves have not studied, being wrong or of such a dubious quality that they should not be taken into account. They are readily believed by virtue of their authority – in line with the notion that “to whom the Lord gives an office, he also gives understanding”.³³¹

Through such an organisational tool, even extremely solid findings long since proven are denied, such as for example, that “weak”, i.e. “non-thermal” electromagnetic fields are strong enough to open VGCCs – cells’ calcium channels – and thus initiate reactions with far-reaching health impacts. [Martin L. Pall cites sources indicating VGCCs can be disturbed by only 7.2 millionths as much power as is needed to heat up water molecules in the interior of cells, that is many orders of magnitude lower than an important reference point for the current limits (Pall ML, Current Chemical Biology, 2016, Vol. 10, No. 1).]

Such institutional arrogance, which is probably rooted in a mixture of ignorance and “shoes being too big”, has been raised as a problem by several people, since it contributes to make central authorities so difficult to move on the issue.³³²

331 Cf. statement from a researcher at the Norwegian Radiation Protection Authority to this author that the opening of the calcium channels “is nothing more than an interesting hypothesis”.

332 Magda Havas, B.Sc., PhD.: When theory and observation collide: Can non-ionizing radiation cause cancer?, *Environmental Pollution* 221 (2017), side 501-505, <https://doi.org/10.1016/j.envpol.2016.10.018>

9. More on the committees and research evaluation

The role of the research evaluation committees is so important that we return to them once more before this document enters into its conclusion:

New accusations are constantly appearing against the ICNIRP-loyal committees. As mentioned, the accusations are about bias, about ICNIRP members acting in multiple roles difficult to combine, for example as a WHO expert to assess cancer risks from mobile phone radiation while also acting as a consultant for the industry (e.g. Anders Ahlbom).

Such criticism is serious enough. These committees are also put in a strange light when biologist and geneticist Martin Pall is able to present a list of 142 literature reviews of in total several thousand research papers showing harmful effects from non-thermal exposures,³³³ while these committees have not been able to spot a single study they find acceptable. As anyone can understand, the odds are against them.

Still, the blindness of such committees is understandable, since just one single good study, i.e., a study in which no significant errors were found, would by standard scientific evaluation criteria constitute enough scientific evidence to conclude that the thermal paradigm on which ICNIRP relies, is founded on sand.

We have also seen that largely the individuals connected to ICNIRP and WHO's The International EMF Project also populate these committees, and their way of work is quite special:

They omit or systematically reject each and every study having found health effects from exposure weaker than the thermally based exposure limits (i.e. the highest columns in Figure 3), only recognising those reports that do not. They then draw the conclusion that exposure limits should remain as they are, but that it would be useful if research was carried out in certain specific areas. One may even suspect these recommendations are to guide research into dead ends or Sisyphus-like areas, like ever more detailed studies of causation or long lasting population studies of effects from an increasing multitude of (short lived) technologies.

Regularly, such expert reviews appear from such literature review committees in the Western world – without finding increased health risks or damage to humans. In fact, there has recently also been such a research review on damage to animals, insects and birds, carried out within the EU project EKLIPSE³³⁴. It used just the same template both as to form and content, and sparked outrage among the environmental scientists and environmentalists in the audience when it was presented, as it cast doubt on the many findings of significant damage.³³⁵

Furthermore, we have mentioned that the *committees' investigations are largely based on each other*. These expert reviews also use an extremely rigid methodology that gives the impression of great accuracy, while hiding a lot of discretion. Their conclusions are based on the part of research finding no connections between dose and response, and hence that "damages have not been proven".

Such behaviour is not in line with a precautionary principle, now part of the constitutions of all modern states, and constantly highlighted as of crucial importance in an age of rapid technological change.³³⁶ Instead, these committees recommend that present or even increased levels of EMF exposure should just continue since "damage is not sufficiently well demonstrated", since the

333 Martin L. Pall: List of 142 Reviews on Non-thermal Effects of Microwave/Intermediate Frequency EMFs, <http://electromagnetichealth.org/wp-content/uploads/2017/10/142-Reviews-Pall-PhD.pdf>, appendix to Letter to California Legislators on 5G Deployment, 7.8.2017,

<http://electromagnetichealth.org/wp-content/uploads/2017/08/Pall-Letter-to-CalLegis-FINAL-8-7-17.pdf>

334 See under 22.01.2018 - 25.01.2018 : *The impacts of artificial Electromagnetic Radiations on wildlife (flora and fauna)* på <http://www.eclipse-mechanism.eu/news>

335 Personal message, Diana Kordas, January 2018.

EMFs' way of action has not been fully mapped, since there have been no independent repetitions of the experiment finding health issues, or similar.

This raises the question of how strict the evidence requirements should be when assessing research.

9.1 How strict should requirements be set when assessing scientific research?

Many conditions are too difficult to investigate directly in practical situations. One therefore has to transpose knowledge earned in lab situations, from studies on cell cultures, or on animals that resemble humans, like pigs, rats and rabbits, and from more distant animals, like fruit flies, living short enough for the scientists to study their development over several generations. Also, doses stronger than real life are frequently used to speed up reactions. Such research opens up for discussions as to whether results can validly be transferred, whether the animals used and humans are similar enough, whether the environment is sufficiently realistic, and so on.

Also, in empirical science, results can never be completely certain. There are always weak points with any empirical research method: The test tubes may have been dirty; you did not look everywhere or long enough before concluding that the outcome X does not happen; there might have been other causes which could produce the same effect; the measurement method was not good enough to detect a cause; etc.

As to any research result, it is therefore always possible to find something which could be criticised, or pointed out as a potential error, bias or suspected fraud.

With this being the case, the requirements for accepting a result as valid, must not be set too high. Otherwise, all empirical research findings would be rejected, and you will never be left with any acceptable findings but the ones based on sheer deduction. One would also easily reject findings that in fact were valid and correct.

Sometimes too rigid quality demands might not be so consequential, but at other times – if, for example, the consequence is to miss a tsunami warning because the observations were not watertight – too rigid quality demands might indeed be very consequential.

Applied to electromagnetic fields and health effects, this means that if you reject any research result where there may be a hint of doubt, you run the risk of also rejecting important research insight. For example, the findings that modern wireless communication seems to cause extermination of insects around the globe.

By setting rigid, or even irrelevant, quality demands, any scientific committee may quickly and schematically reject solid research reports in general ways, for example with the argument that only a statistical correlation has been demonstrated, but not the causation, nor the mode of action. Or by claiming that the damage causing mechanisms have not been sufficiently proven, that the symptoms are not manifest and objectively observable (called “substantiated” in ICNIRP terms), or because research studies also exist where no such findings have been made, or simply because that very committee categorically rejects all research finding health effects not connected to a specifiable energy intensity threshold, i.e., without heating, *as such health effects should not be possible according to the thermal dogma on which the quality demands are based.*

Upon careful review, one will find all these justifications for rejecting findings of sub-thermal health effects in use throughout these committee reports.

336 Harremoës, Pierre et al: The Precautionary Principle in the 20th Century –late lessons from early warnings, European Environment Agency, Earthscan Publications Ltd, London, 2002

In such cases, one “throws the baby out with the bathwater” and is left just with such research that finds no connections between dose and response at sub-thermal exposure levels. When after such processes, you base your conclusions on the research that passed your evaluation, you may get the national radiation protection agencies, not to mention politicians – neither of whom themselves have the capacity to verify the assessments – to admire your carefully elaborated evaluation method, and make them believe that “the knowledge base ” or “the research taken as a whole” “*does not provide a basis for stricter limits*”.

The purpose of *the precautionary principle* – both when introduced in the late 1970s and now when re-born as a constitutional principle of state administration in the 2000s – was precisely to furnish governments with a tool that could save them from becoming so critical that they reject findings of great significance for individuals, society and the environment, just because they are not completely “100% proven”, or because the risk of not acting is too great. The precautionary principle contradicts the idea that extremely rigorous standards of proof – indeed, *unattainably* rigorous standard of proof – should be used, and tells us that the idea of the thermal paradigm as a basis for exposure standards should be overturned.

As to the question of what weight of evidence is required, such a question cannot be answered from scientific theory. The acceptable level of impacts is a political issue, a question left for the battle between stakeholders, governments and societal interests, ethics and social responsibility.

How certain must findings be for them to be accepted as a basis for practical measures to be taken? It depends on perspective and on ideology. The environmental movement has demanded that society should act preventively on *indications* of environmental damage. Business liberals generally want the opposite, very strict evidence of damage or acute hazard to humans, before accepting restrictive regulations. ICNIRP and the practice that ICNIRP recommends in its policy document, supports such a practice – just what business liberals have traditionally wanted and paid for.

Hence, the answer as to how certain findings must to be accepted as a basis for practical measures is political and ethical, not scientific.

9.2 Academic criticism of these committees' assessments

From time to time, more academically informed criticism of these committees is published. Such criticism analyses their work and points at errors and shortcomings as to academic standards. Out of the many science based criticisms at hand, only four very different ones shall be mentioned here:

- In his note “Electromagnetic fields from wireless communication and health – scientific evidence versus observation and experience”,³³⁷ physicist and researcher Leenart Vries, research leader and Philips Research Fellow for a number of years, takes a crystal clear stand against the evidence requirements in these ICNIRP inspired reviews. He gives examples of how overwhelming the scientific evidence is for health damage from weak radio frequency radiation. The paper shows, from a theoretical starting point, how the requirements for providing evidence in these committee reviews are unprofessional and unreasonable, stricter than normal in the medical profession, how they hinder a precautionary policy, and how they serve as a barrier to stricter regulation needed to avoid since long established harmful effects on people and the environment.
- Martin L. Pall, professor emeritus of biochemistry and basic medical sciences at Washington State University, published a paper in 2015 in which he made very strong criticisms of a report by Canada's committee on radiation safety, the “Safety Panel”. His criticism is aimed

337 Dr. Leendert Vries: Electromagnetic fields from wireless communications and health - ‘Scientific proof’ versus ‘observation’ and ‘experiences’, <https://www.iemfa.org/wp-content/pdf/Scientific-proof-versus-observation-and-experiences.pdf>

at weaknesses that are common to these committee reports. He points at omissions, misinterpretations, misclassifications and biased assessments which lead to the filtering out of good research results in favour of those studies that have not made discoveries, which are of less or no importance in the light of Karl Popper's hierarchy of evidence (discussed in section 4.2.1). He finds that the Canadian report – after filtering out relevant findings – rests on the weakest type of presentation of evidence among Popper's categories: The report is based on the studies having found no connections between exposure and biological effects, while unjustifiably omitting the ones which have.³³⁸

- In a rather differently written article, the neurologist Sarah Starkey analyses a scientific review carried out by the (now defunct) UK permanent committee AGNIR, the Canadian equivalent of the above. She demonstrates how the AGNIR committee report is characterised by omissions, misinterpretations, misclassifications and other properties that consistently lead to research contradicting the thermal paradigm being omitted, or considered too weak. On the other hand, research which can be interpreted to support the thermal paradigm – as it finds nothing, is used as “evidence” to support the conclusion.³³⁹
- The most recent Norwegian science review committee report, FHI report 2012:3, received roughly the same type of criticism in a “counter-report” on the very same day it was handed over to the then Minister of Health, Jonas Gahr Støre. One of the authors, research scientist Solveig Glomsrød, had been an observer in the committee as chair of FELO, the Norwegian association for the electro-sensitive. The report accuses the committee behind the FHI report of much the same as does Starkey as to AGNIR and lists specific articles that would change conclusions significantly if they were taken into account by the committee.³⁴⁰

The accusations made in these and a number of similar analysis and criticisms have strong resemblances with the accusations of systematic distortion of evidence brought about decades earlier against “tobacco research” – the largely industry-funded research casting doubt on any research results finding connections between smoking and health damage.³⁴¹

9.3 Norway's radiation protection – “more Catholic than the Pope”

ICNIRP's guidelines prescribe that more restrictive exposure limits should be considered to cater for the possibility of higher sensitivity or vulnerability among such as the elderly, children and ill persons. In its 1998 recommendations, ICNIRP even recommends (Page 506 of ICNIRP 1998, p. 506) specific and substantially lower exposure limits to protect against tinnitus and damages to the retina. The EU and EEC regulation EU Recommendation 1999/519/EC repeats these restrictions.

Neither of these fully legitimate opportunities – and even calls for action – to set exposure limits stricter than just protecting against acute damage from tissue heating, are followed up, not to

338 Pall, Martin L: 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, *Rev Environ Health*. 2015;30(2):99-116. doi: 10.1515/reveh-2015-0001.

339 Sarah J. Starkey: Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation, *Rev Environ Health* 2016; 31(4): 493–503, DOI 10.1515/reveh-2016-0060

340 Glomsrød, Solveig and Solheim, Ida: Health effects of electromagnetic fields, 2012, download from https://www.felo.no/wp-content/uploads/2021/11/Helsevirkninger_av_elektromagnetiske_felt-felo_content_download_4761_36728_file_Helsevirkninger_av_elektromagnetiske_felt.pdf.pdf

341 Sheldon Rampton og John Stauber: “Trust Us We’re Experts: How Industry Manipulates Science and Gambles with Your Future”, 2008; and Erik M. Conway and Naomi Oreskes: *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, 2012.

mention exploited, by the Norwegian Radiation Protection Authority. The expressions “whitewashing” and “being more catholic than the Pope” come to mind:

Last time a committee was appointed (on request by the Radiation Protection Agency) in Norway to review the state of knowledge as to health impacts of man-made EMFs and to evaluate the Radiation Protection Agency's work was in 2012 (FHI 2012:3) after some unrest in media about whether the Radiation Protection Agency's limits were sufficiently strict.³⁴² [Addition as of summer 2023: A minor follow up status report, based on a selection of status reports, is due for publishing during the fall 2023, ordered by the Radiation Protection Agency.]

Apart from the project management and secretariat from the Norwegian Institute of Public Health, the committee consisted of researchers associated with the Norwegian and Swedish radiation protection agencies and ICNIRP, with just a very few exceptions. Their report concluded that research findings did not warrant any regulatory changes at all.

The committee found weaknesses in absolutely all the research finding harmful effects that it chose to investigate. It underpinned its conclusions by referring to a number of reports from ICNIRP and other countries' national committees that had also reached the same conclusion. How other countries' national committees, such as Israel, Russia, the former East Block, China and Italy, among others, had reached other conclusions, was not explained.

Hence, according to the committee, there was no reason to have stricter limits than the values suggested in the ICNIRP guidelines to protect against tissue heat damages.

This Norwegian committee thus joins the ranks of semi- or fully governmental committees in a number of Western countries which reach conclusions clearly contradicting the mainstream of research. It legitimises using the ICNIRP's guidelines without any further restrictions by casting doubt on – or omitting – references to extremely strong scientific findings, and washes its hands by pointing at the never ending “need for more research”.

As mentioned earlier, this committee was – as many of the similar committees referring back and forth to each other's reports – strongly criticised in a "counter-report", among other things for its very selective use of sources and its bias in personnel selection.³⁴³ This criticism had no practical consequences whatsoever.

The consequences of such a radiation protection policy are obvious in the context of AMS/smart meters:

A conflict arises between "facts on the ground" and the Radiation Protection Authority's guidelines. With this conflict, follow conflicts between government agencies, as well as and demands of loyalty between them. This happened between the NVE – deploying AMS meters which they were warned would make people ill, and therefore permitted an opt-out, while The Radiation Protection Authority assured that no health issues could arise. The Norwegian Directorate of Health in spring 2018 rushed to help out the NVE by prohibiting doctors from issuing certificates stating people could actually become ill from AMS/smart meters.³⁴⁴

342 Jan Alexander et al.: Weak high-frequency electromagnetic fields – an assessment of health risks and management practices, FHI report 2012:3, Folkehelseinstituttet, 2012, <https://www.fhi.no/publ/2012/svake-hoyfrekvente-elektromagnetisk/>, English summary: <https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2012/low-level-radiofrequency-electromagnetic-fields--an-assessment-of-health-risks-and-evaluation-of-regulatory-practice.-niph-report-20123.pdf>

343 Grimsrød and Solheim op. cit., see note 340

344 Directorate of Health: Medical certificate and automatic current meters, 14.03.2018, <https://helsedirektoratet.no/nyheter/legeattest-og-automatiske-straummalarar>

These conflicts and loyalty games are open for anyone to see. They are highly destructive as to the credibility and confidence to government on which our society is built, and trigger all kinds of very unfavourable speculations as to the underlying motives, when not even the most obvious physical reactions to AMS meters easily observed among electro-sensitive people, are denied.

The exposure limits recommended are set at levels not even suggested by ICNIRP:

ICNIRP guidelines only deliver a first step for setting exposure limits – energy intensity thresholds not to be exceeded in order to prevent acute tissue damage – as tested on dogs, rats and mannequins roughly imitating a full grown male athlete. The ICNIRP guidelines do not [not even in the ICNIRP 2020 guidelines] claim such limits to provide adequate radiation protection for the population. They only claim that the proof that further restrictions are needed, is not solid enough to satisfy ICNIRP's extreme and misplaced demands for evidence.

As we shall see shortly, this was the lesson learnt by the tobacco industry: “Do not claim the findings of damage wrong! Just claim they are not certain!”

9.4 The Norwegian view of electromagnetic (hyper)sensitivity – a consequence of the thermal paradigm?

Gunhild Oftedal, a researcher at what was until recently the College of Sør-Trøndelag, now part of the Norwegian University of Science and Technology (NTNU), is currently [as of 2018] associated with ICNIRP as a member.

She has been researching the health effects of mobile phone use since the early 1980s and has never made significant findings of health damage. She delivered a commissioned investigation which became central in FHI report 2012:3 as the basis for the committee's conclusion on electro-hypersensitivity. Oftedal's study³⁴⁵, which reviews some very crude lab experiments exposing individuals of EMFs in order to investigate whether electro-hypersensitivity has a physiological or psychological cause, constituted an important part of the basis for the committee's conclusion. Thereafter the stand taken by the Norwegian health authorities was that “so-called” electro-hypersensitivity (EHS) cannot be demonstrated and that the symptoms and the experience therefore must have other causes than exposure to EMF, possibly psychological ones (i.e. nocebo). In accordance with the conclusions on EHS found in the Proceedings from the WHO International Workshop on EMF Hypersensitivity (Prague, 2004), based on the very meagre study by Lena Hillert, Oftedal also concluded that the most appropriate medical measure would be *cognitive therapy*. (Such therapy has been documented to have very little effect, far less when compared to shielding or removing the source.)

Oftedal's investigation was in line with ICNIRP's thermal paradigm, but in sharp contradiction to the many observations of “facts on the ground”, to the WHO's disease classification system ICD-10 (English version), and to a number of central sources. Also, it contradicted extensive historical material. (See Electro-hypersensitivity, Chapter 2.)

The importance of the thermal dogma is here well demonstrated: The view as to what can possibly be the most efficient therapy follows automatically from the dogma: Electro-hypersensitivity can not possibly be caused by exposure to electromagnetic fields as long as no heating takes place. Thus, the recommendation must forcibly be cognitive therapy, as less exposure can by sheer logic not have any possible physiological impact. Hence, cognitive therapy also became the treatment recommended by the FHI report.

345 Oftedal, Gunnhild: "Electro-hypersensitivity – Investigation into causes and possible measures and treatment plans", investigation commissioned by the Norwegian Social and Health Directorate, Sør-Trøndelag University College, Dept. of Technology, 2006

The gap between the “ICNIRP environment” and the mainstream of scientific research is particularly clear here:

Oftedal's and the committee's conclusion that electro-hypersensitivity is just a psychological condition for which adequate treatment is to offer cognitive therapy, is in direct contradiction to the knowledge base behind the EUROPAEM 2016 guidelines.³⁴⁶ These guidelines prescribe the use of conventional environmental medicine diagnostics, specifies physiological tests and prescribes therapies which – in contrast to cognitive therapy – have been proven to be quite efficient: First and foremost to remove the source of radiation, and if not feasible, then shielding oneself from it.

[It should be added that Oftedal and co-authors have later come to the conclusion that all tests of EHS so far have been unsatisfactory from a scientific point of view, and also, that there is experience from the EHS afflicted that should be exploited when constructing such tests. See Schmiedchen, Oftedal, et al. (2019), E.F. 2023]

The thermal paradigm, together with an exaggerated and unfit demand for proofs, has become a blindfold for the health care system in Norway as well as in many other countries, leading to mistrust, degrading treatment and to therapies that are prolonging the symptoms and increasing the health problems of many individuals, in stead of the other way around.

346 EUROPAEM 2016, op. cit., see note 33

10. The similarities with the PR campaign for tobacco, PCBs, lead, GMOs, asbestos, etc.

It has been carefully documented, also through internal documents from the American tobacco industry itself, that the industry hired a number of PR companies to defend its interests when threatened by research demonstrating health damage from both active and passive smoking.³⁴⁷

The same applies to a number of other industries that have environmental toxins or health-damaging substances in their portfolio – PCBs, lead, asbestos, GMOs, glyphosate and other pesticides, pharmaceuticals, etc.

According to one of the analyses, the hired PR agencies used a repertoire of tactics which mainly consisted of the following³⁴⁸:

- Do not try to win the "war for the truth", as it is enough to cast doubt on the other party's research results.
- Do not contradict credible research, but just cast doubt on whether it may be right.
- Establish an apparently independent body of experts, which can gain credibility as a professional organisation.
- Set up interest groups appearing to be defenders of health and the environment, but do at the same time work to defend the industry's interests and reduce the authorities' regulation of the industry, particularly by opposing any precautionary policy.

For example, PR firms set up a number of expert committees, commissions, research institutes and activist groups to promote the interests of these industries – without disclosing their industry alliances. There are also a number of examples where a PR company produced half finished research papers and then paid medical doctors to complete them. If necessary, journalists were paid to publish the articles.³⁴⁹

10.1 To what extent do the tobacco industry's strategies also prevalent in the ICT sector?

The following points show particularly strong similarities:

- A review of amendments proposed by the industry to regulatory authorities (FCC etc.) asking for revisions of radiation protection guidelines, demonstrates that the industry has on several occasions – through CTIA,³⁵⁰ IEEE and ICNIRP – proposed amendments which gradually have made the guidelines and calculation methods *more lax*.³⁵¹

347 Sheldon Rampton and John Stauber: "Trust Us We're Experts: How Industry Manipulates Science and Gambles with Your Future", Tarcher/Putnam, N.Y., 2001.;

Erik M. Conway og Naomi Oreskes: Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, 2012;

Clive Bates and Andy Rowell: Tobacco Explained - The truth about the tobacco industry ...in its own words, Action on Smoking and health (ASH), <https://escholarship.org/uc/item/9fp6566b>

348 Rampton & Stauber, op.cit., see note 347

349 Ibid.

350 CTIA is the US mobile industry's trade organisation. The leader for many years was Tom Wheeler, who became the FCC's leader under Obama.

351 Devra Lee Davis PhD MPH, Alvaro de Salles PhD, Susan Downs MD, Gunnar Heuser MD PhD, Anthony B. Miller MD, Lloyd Morgan BSEE, Yael Stein MD, Elihu D Richter MD MPH: Erroneous Comments Submitted to the FCC on Proposed Cellphone Radiation Standards and Testing by CTIA – The Wireless Association, September 3, 2013, FCC 13-39, November 18, 2013, <https://ehtrust.org/wp-content/uploads/2013/11/FCC.pdf> (consultation statement to the US Telecom regulatory authority FCC)

- ICNIRP was established as a formal independent expert body. However, ICNIRP reproduces and defends the outdated “thermal dogma” as basis for its guidelines, thereby serving industry. It also makes experts available for committees, organises seminars, builds networks conducting research and conducts reviews that provide the input for other knowledge reviews, such as the most recent Norwegian review of scientific knowledge (FHI 2012:3). ICNIRP appears to be independent, but has strong ties to industry and defence.³⁵² ICNIRP conveys a view that promotes generous limits – contrary to the main body of research – while being careful not directly to contradict it, just to discredit it.
- The industry finances “counter-research” – research appearing to be serious, but which, due to its premises, research design, topic or other factors, finds only weak or no connection between exposure and health risks, thereby playing a part in a more or less intentional “war-gaming operation” against the well demonstrated findings of health risks from EMFs.
- The committee's assessments are based on the use of *negative evidence*, i.e., the weakest possible evidence, based on research finding no dose – response-connections, and on the *political* – not scientific – view that markets should not be regulated unless harm is solidly demonstrated. Such a policy view is directly contradicting the precautionary approach.
- These committee reviews – which should map the “status of knowledge” – are subject to strong criticism for conveying a distorted understanding as to what is established scientific knowledge, biased in an industry-friendly direction.
- The committee reviews do not directly claim that research reports contradicting the thermal dogma are wrong, but that they are deficient and thus should be discarded. *They cast doubt on all such findings and call for more research. In stead of advocating a precautionary approach, they argue for the opposite: “No reason for tighter limits since health damage has not been demonstrated”.*
- Even studies which, through peer and editorial reviews are assessed as outstanding by medical and/or biological standards and should therefore be used to form exposure guidelines, are simply passed in silence by the “ICNIRP circle”, or they are in their reviews considered too uncertain to be given weight or to have practical implications.
- In practice, the committees demand evidence in infinite regress – i.e. constantly demanding more evidence. In empirical sciences, claims for better evidence may always be raised, and may be used as a filibuster technique to delay restrictions of critical importance for health and for the environment. This corresponds well with the strategic point lifted forward above: You don't need to win. It is good enough to cast doubt that delays regulations.
- These committees always end up calling for more research, which means that more time will pass, while they claim by implication, i.e., without stating so clearly, that the thermal paradigm is a principle safe enough for designing exposure limits.
- It has been extensively documented how several of the research projects having most clearly demonstrated damage mechanisms and increased health risks from microwave radiation and in particular from pulses, as well as the researchers behind them, have been exposed to attacks and smear campaigns. These campaigns have been run by people associated with the industry as well as by radiation protection authorities, with the intention of undermining trust by false accusations. This applies, for example, to the

352 “A Radiant Day”, NRK Brennpunkt (23.09.2008), see note 262

EU-funded REFLEX study which clearly found harmful effects of pulsed low-frequency radiation on cell cultures, as well as cancer researcher Lennart Hardell's studies on the risk of brain tumours from mobile and DECT phone use, and American studies of DNA damage from mobile use.³⁵³

- There are analyses demonstrating how several research projects used by the industry and the authorities to legitimise today's exposure limits have been designed so that they could not possibly find statistically significant differences between the exposed group and the control group. (See section 10.3.)

At all these points, the defence of the “thermal paradigm” conforms to the PR strategies used by the tobacco and other industries having to defend themselves against the accusations of imposing health hazards, in order to prevent stricter regulations.

There are therefore good indications – though not proven here – that we are facing a carefully crafted repetition of the scandals surrounding lead, PCBs, silicosis, asbestos, etc.:

A health and environmentally harmful practice within the wireless industry is defended by using the old tricks from the PR industry handbooks – by casting doubt on and denying research-based knowledge of harmful effects even at exposures below the exposure limits; by establishing an apparently neutral third party – ICNIRP – as a research and assessment institute; by trying to direct research resources into uncharted areas of fruitless or endless work; by financing/performing “counter-research”; by lobbying; by actively participating/influencing national/regional/international policy in the field, and by otherwise discrediting scientists and their findings; as well as preventing reforms and new knowledge from spreading.

We do not need to assume or decide on whether any such intentional fraud or cheats are carried out by Norwegian authorities or by other European or Asian governments: Since World War II, the USA has been, and still is, setting the tone for large parts of the globe with regard to exposure limits and technical communication standards. Generally speaking, business ethics seem to be quite a lot tougher there than in Europe, not to speak of Norway. What happens in the USA, is, essentially, decisive for Norway, the Nordic region and Western Europe. Hence, it is of great importance for regulation of the sector how the balance is set between the industry and regulatory authorities in the USA:

The US Federal Communications and Radiological Protection Authority, FCC, has now over a number of years been led by people coming from top positions in the mobile phone industry. The positions have almost been bought through election campaign contributions to presidents Clinton, Obama and Trump. The immediate effects have been seen on industry regulation: It has become more lax, e.g., through forced start of 5G without investigation of health and environmental consequences, and before that, through changes in calculation and measuring methods making it possible to transmit with higher power.

Countless attempts to gain acceptance that health hazards must be assessed based on parameters other than the risk of heating, not the least in the USA, have failed. The FCC is not interested, and a similar change has occurred in recent years in other central US federal bodies, e.g., in the FDA.

The close ties in the USA between the wireless industry, the defence industries, the armed forces and the FCC have been documented,³⁵⁴ and the close connections to the ICNIRP have been

353 E.g. Adlkofer, Franz: Our protection against radiation is contrary to science, lecture at the Safra Center for Ethics, Harvard University, 2011, (video on the same issue here: <https://youtu.be/B9ycyWd8GMs>); and Carlo, G. & Schram, M. (2001). Cell Phones' Invisible Hazards in the Wireless Age. N.Y.

354 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, http://ethics.harvard.edu/files/center-for-ethics/files/capturedagency_alster.pdf

demonstrated in numerous documentaries, among others the Norwegian Broadcast Corporation’s documentary “Ein strålande dag”.³⁵⁵

10.2 Funding biased research and deception

A very clear connection between funding sources and scientific research outcome – *in this case* whether the research finds harmful effects on health – *has been demonstrated*. Several studies have identified this pattern, here you will first see a graph based on figures from the ORSAA database on scientific papers on EMFs and biological health effects.³⁵⁶

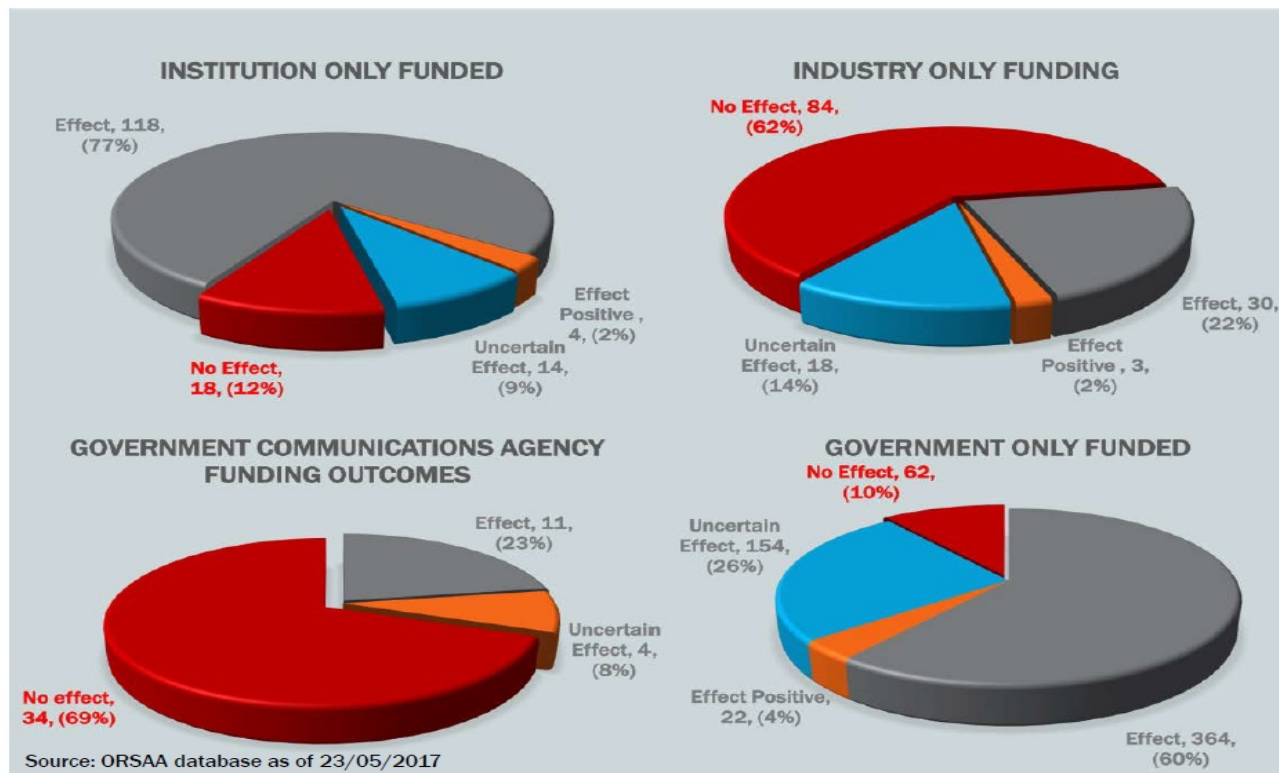


Figure 38: ORSAA database: Proportions of positive findings varies strongly with funding

The pie charts show that while freely funded research found effects in 77% of the studies and 60% of purely state-funded research also did, industry-funded research and research funded by the communications agencies found effects in only 22% and 23% of the reports, respectively.

An earlier analysis of research on cancer from microwave radiation shows similar results: Research funded by industry makes far fewer discoveries of cancer than does independent research. This can be seen from the table in Figure 39.³⁵⁷

355 NRK Brennpunkt, op. cit., see note 262

356 Steven Weller: Electromagnetic Hypersensitivity, May 2015,

<https://stopsmartmetersau.files.wordpress.com/2015/06/steves-emerg-ehs-presentation.pdf>

357 Source: Carlo, G: The Latest Reassurance Ruse About Cell Phones and Cancer, J. Aust. Coll. Nutr. & Env. With. Vol. 26 No.1 (April 2007) page 1-4, https://www.powerwatch.org.uk/pdfs/20070105_conflict_carlo.pdf, discussed and translated into Norwegian in Flydal, Einar: Norwegian healthcare based on American-Danish fraud, 20.12-2014, <https://einarflydal.com/2014/12/20/norwegian-healthcare-based-on-american-danish-fraud/>

Table 1		
Statistically Significant Findings from Key Epidemiological Studies^{1,2} of the Link between Cell Phones and Tumors by Source of Finding – Independent or Industry		
	<u>Number</u>	<u>Mean Risk Ratio³</u>
Independently Funded		
Positive Findings (show a link)		
Malignant Tumors	182	2.7
Benign Tumors	25	2.7
Negative Findings (show no link)		
Malignant Tumors	0	0
Benign Tumors	0	0
Industry funded		
Positive Findings (show a link)		
Malignant Tumors	59	1.2
Benign Tumors	39	1.5
Negative Findings (show no link)		
Malignant Tumors	1	0.7
Benign Tumors	16	0.6
Footnotes:		
1. Includes the recent Danish cohort study		
2. Appearing in peer-reviewed journals since 2001		
3. For example, a risk ratio of two indicates a doubling of the risk of tumours in cell phone users		

*Figure 39: Industry-funded research finds far fewer cancer cases
(Source: G. Carlo, April 2007, see footnote 357)*

Dr. Henry Lai, one of the first researchers to demonstrate DNA damage from non-ionizing radiation, examined the results of cell phone studies that documented biological effects (within a specific area) and found that the results depended on who funded the study.³⁵⁸ Similar results have been found in other studies, also by ICNIRP affiliates like Huss and Rösli.³⁵⁹

358 Lai, Henry, from presentation given at Lakehead University in Thunder Bay Ontario on February 22, 2010, <https://magdahavas.com/electrosmog-exposure/schools/wireless-concerns-at-lakehead-university/>

359 Huss A, Egger M, Hug K, Huwiler-Müntener K, Rösli M. Source of funding and results of studies of health effects of mobile phone use: systematic review of experimental studies. *Environ Health Perspect* 2007;115:1–4. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1797826>

The question arises how this close correlation is caused: Whether such patterns are the result of intentional acts in order to finance fraud and deception, or result from unintentional processes where money tickles down to the most suitable “scientific sub-culture”, the one delivering the answers favourable to the stakeholders’ interests. Statistics do not answer such questions.

10.3 Designing research in order not to find harm

It has been demonstrated in detail how several specific projects have been designed in such a way as to avoid conclusions of significant findings of health impacts.

Among the well-known projects where this has been demonstrated are: WHO/GSMA's large *INTERPHONE* project³⁶⁰, the large Danish *KOHORT* project³⁶¹ and Alexander Lerchl's extensive experiments with guinea pigs³⁶². According to the source, the latter was used in the large German government program, The German Program for Research on Mobile Telecommunications 2002-2008, to legitimise the conclusion that no effects could be demonstrated.³⁶³

The large study involving irradiation of mice and rats under the USA's *National Toxicology Program*, which has been carried out over the past few years under government auspices, created major media reports in 2017 and 2018 when findings were made public, as it found an increased risk of cancer. Soon after, the findings were “interpreted” through several rounds of statements from industry affiliated researchers, the project manager was replaced, etc. and the conclusions dampened down.³⁶⁴ The Swedish former ICNIRP member and participant in the committee behind the FHI report, Maria Feychting, was one of those who came out early to cast doubt on the report.³⁶⁵

However, the state-appointed panel of experts who were tasked with peer-reviewing the study, chose to strengthen its seven conclusive statements on harmful effects. The NTP expert panel found, among other things, clear evidence for a rare type of malignant heart cancer and some evidence for malignant brain cancer in rats.³⁶⁶

Criticism has also been raised that the NTP project was designed – whether wilfully or not – so that the differences between exposed rats and the control groups would be reduced: The testing was carried out in the US’s mobile industry's research facility. A large number of technical details indicate that the control group was significantly exposed as well.³⁶⁷

360 The INTERPHONE project was first presented in summaries where data were grouped so that correlations disappeared and with the conclusion that there was no evidence of increased cancer risk from mobile phone use, and only half a year later was the data basis, which showed correlations, presented. See also Interphone: The Cracks Begin To Show Cardis Endorses Precaution, Microwave News, June 19, 2008 <http://microwavenews.com/news-center/interphone-cracks-begin-show>

361 Carlo, G: The Latest Reassurance Ruse About Cell Phones and Cancer, J. Aust. Coll. Nutr. & Env. With. Vol. 26 No.1 (April 2007) page 1-4, discussed and translated into Norwegian in Flydal, Einar: Norwegian healthcare based on American-Danish fraud, 20.12-2014, <https://einarflydal.com/2014/12/20/norsk-helsevern-basert-pa-amerikansk-dansk-svindel/>

362 For analysis of Lerchl's project, see Adlkofer: “Our protection against radiation is in conflict with science”, Harvard lecture 2011, www.folkets-stralevern.no/wp-content/pdf/adlkofer-11.2011.pdf

363 Adlkofer 2011, op. cit., see note 362

364 What Changed at NTP?, Same RF Cancer Data, Different Outlook, Microwave News, February 7, 2018, <http://microwavenews.com/news-center/what-changed>

365 The Anatomy of a Rumor - Karolinska’s Maria Feychting Cites Pathology Bias To Discredit NTP RF Cancer Study, December 2, 2017, <http://microwavenews.com/news-center/anatomy-rumor>

366 Sources in the references at the bottom of the following text: <http://www.folkets-stralevern.no/nyheter/statlig-oppnevnt-ekspertpanel-fastsjar-at-mobilstraling-kan-forarsake-kreft/>

367 Firstenberg 2018, see note 191

11. Crisis of confidence and fragmentation of responsibility

Modern, democratic societies are highly dependent on the legitimacy of the governmental bodies. Societies brake down when public administration or other bodies acting on their behalf are distrusted by the public. What has happened with the roll out of AMS/smart meters has created such distrust – and for reasons evident to everyone:

The power grid companies assure customers that radiation from their smart meters is so weak that health effects cannot happen. To justify their statements, they refer to the fact that radiation from their meters stay well within rules and regulations and refer to statements from the national Radiation Protection Authority telling that radiation is negligible, and even much weaker than the radiation from mobile phones.

At the same time, they excuse themselves by stating that the introduction of such meters is a requirement imposed on them by the national electricity authority, in Norway the NVE, without mentioning they are themselves responsible of the technology chosen. Also, they promote all the advantages of not having to read the meter yourself and other advantages of having a "smarter" home.

In its turn, the NVE refers the question of health effects from the meters to the Norwegian Radiation Protection Authority, explaining that those who work in NVE are civil engineers with no knowledge as to health effects from microwaves, as this is the domain of the Norwegian Radiation Protection Authority. Neither does NKOM, the directorate for telecommunications: NKOM, too, knows nothing about health and radiation protection, and points to the National Radiation Protection Authority. The Directorate of Health, which is responsible for administrative matters related to health, loyally defends its sister agency, referring to the Norwegian Radiation Protection Authority and the FHI report. The Department of Health and Care also defends the Radiation Protection Agency's assessments, which as we have seen are not actually made by the Agency, and declares that Norway "follows the WHO and the expert body ICNIRP", which in fact, Norway does not do at all: Norway follows a tiny office in the WHO that relays the message from ICNIRP that to complement the ICNIRP exposure limits recommended to protect against acute damage from heating, each individual country should make their own assessments and formulate their own limits, a job Norway leaves to various committees dominated by ICNIRP members who never find any of the correlations documented in the lion's share of research reports over many decades, and "therefore" conclude exposure limits should be set equal to ICNIRP's recommendations, i.e., to protect against heat only.

Many amateurs and experts, both in Norway and in other countries, understand very well that this does not add up – that it is a game played to show off objections, to make people believe the situation is better than it is. And many people understood so long before I did myself. To those affected by EHS, this mix of "Potemkin façade" and outdated or simply poor science, hurts badly. They feel it on their bodies, and easily understand that each and every link in the chain washes its hands, sending them around in an Escher-like labyrinth.

Cleaning up this mess is a demanding exercise, but it can be done, and *must* be done. It should start in the national Radiation Protection Authorities and those who hold their hand over these agencies:

The Radiation Protection Authorities are the ones in charge of this area, the subject of this document. They pass on assessments made by industry biased bodies in ways that make them take on the role as "Information Offices of the wireless industry" – seemingly neutral expert bodies which ensure that restrictions on the industry's freedom of action are limited and deferred – or they

even favour laxer limits and less regulation in countries having found solid reasons for stricter exposure limits.

Unless looking into the details, as we have done in this document, we do not see how this takes place. It by small moves, step by step, in seemingly small and technical ways, such as by increasing the time or the area over which average measurements are to be calculated, or by using average measurements even though it is been known for a long time that short pulses – which barely leave any trace in the average measurements (see section 5.3) – are of crucial importance as to biological effects.

The Radiation Protection Authorities, in Norway as elsewhere, should adapt to reality, rebuild trust and stop sending out messages that everyone easily can understand are wrong. Like the claim that the AMS/smart meters “are so weak compared to mobile phones”, that the health hazard is insignificant and cannot have any biological effect. This claim is still found on information material all over Norway, but is based on mixing up two different measurement methods (e.r.p. and e.i.r.p.).³⁶⁸

In fact, the radiated power of AMS meters – at full power, which is standard when such measures are made – is three times as strong as the radiated power from 3G and 4G mobiles (which today account for approx. 95% of mobile traffic in Norway, and therefore the relevant measuring stick).

This is essential information for anyone with EHS as well as for anyone wishing to live in a low radiation environment. For the Radiation Protection Authority, the faulty statement is of little importance, as “the radiation is negligible anyhow” when compared to the risk of overheating. Even after being informed about the mistake, and conceding it had misinformed, the Radiation Protection Authority was unwilling to correct its statement.³⁶⁹ Hence, it goes on misleading other actors of public services within healthcare, as well as NVE and other agencies, the grid companies and their customers. Repeated *ad infinitum* even though health effects from AMS meters are experienced by animals as well as humans, such behaviour creates great distrust. One easily understands: “The king has no clothes”.

A mobile phone is only active for a small part of the day and the user can switch it off anytime and put it away at night. AMS meters cannot be switched off, and transmit continuously 24 hours a day.

Figure 40 shows actual measurements in practical situations: We see the measurements of two AMS meters (to the right) and two mobile phones (to the left) in real situations where the two meters are in their normal activity and the two mobile phones are switched on but inactive. Distance from measuring equipment, scales and duration are identical. Figure 40 shows that the emanating power from the meters are clearly very much stronger than from the mobiles, and also that the pulsation from the meters is much more frequent, especially from the meter installed in most households – of the Finnish brand Aidon.

The Norwegian Radiation Protection Authority does not want to share this information with NVE, the grid companies, nor with the public. The agency writes so in clear terms.¹

Compared to the findings of health hazard explained in this document, what degree of radiation protection do we really have? This state of affairs should not be permitted to go on, or should it?!

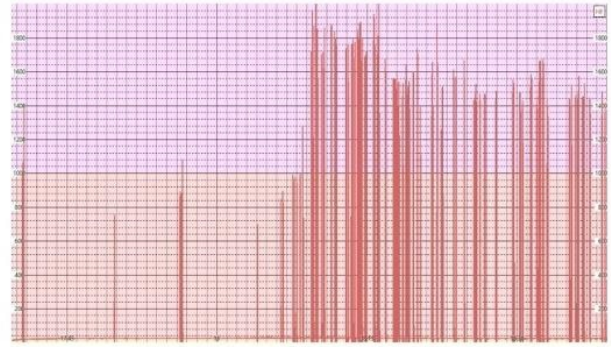
368 <https://einarflydal.files.wordpress.com/2018/05/langsom-ferd-mot-innrc3b8mmelsen.pdf>

369 The case has been reviewed in Flydal, Einar: The Radiation Protection Agency admits: has misinformed about the strength of the AMS meters, blog post, 03.05.2018, <https://einarflydal.com/2018/05/03/stralevernet-innrommer-har-feilinformert-om-styrken-pa-ams-maljerne/>. The correspondence is collected here: <https://einarflydal.files.wordpress.com/2018/05/langsom-ferd-mot-innrc3b8mmelsen.pdf>

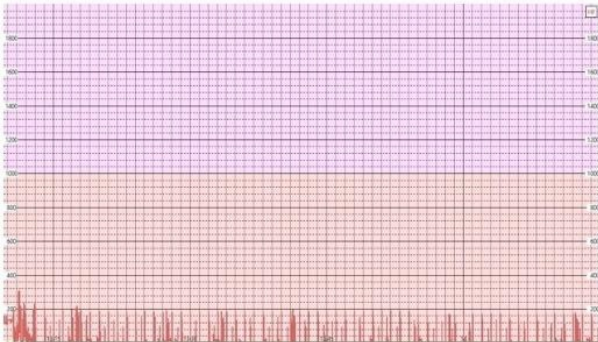
To compare the electromagnetic fields from mobile phones and the new Smart Painters (AMS), EMF CONSULT has carried out a 1-hour log at a distance of 3m with identical scaling on the graph (max. 2,000 $\mu\text{W}/\text{m}^2$).



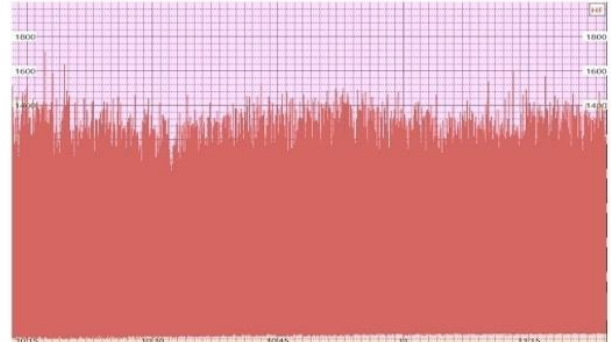
Log 1: Samsung S7 with only GSM, without wifi, Bluetooth and 4G (in passive state, the phone just lies on the table).



Log 3: Kamstrup AMS Slave (Concentrator point)



Log 2: iPhone 7 with wifi, Bluetooth, 4G and GSM (in passive mode, the phone just lies on the table).



Log 4: AIDON AMS Slave

Figure 40: Comparison of two mobile phones (left) and two meters (Kamstrup and Aidon) in real situations.

12. Practical solutions related to AMS/smart meters

12.1 Measures to remove or reduce biological damage

Theories and practical experience suggest that in many cases permanent electro-hypersensitivity results from heavy exposure.^{370,371} Therefore, protective measures should preferably be taken *before* the installation, not afterwards.

Generally, one basic ingredient of medical treatment against damage from environmental toxins consists of removing the source, shielding yourself from the source, or getting away from it, i.e. various forms of reducing exposure.³⁷²

In the aforementioned guidelines from EUROPAEM, instructions are given according to traditional methods within environmental medicine, including diagnostic tests, and as to diagnostic and therapeutic measures in order to eliminate acute health effects while also minimising long-term effects. Research reports and clinical experience by and large show *very favourable effects* from reduced exposure.³⁷³

Norwegian health policy – as well as health policy in countries “following ICNIRP” – has a different view, in accordance with those committees they refer to:

As Norwegian health policy is to follow the “thermal dogma”, it is not possible for Norwegian health authorities to recommend reducing exposure, e.g., by shielding, as a therapeutic measure. Instead, as we have seen, *cognitive therapy* is recommended. That cognitive therapy show very poor results against EHS, should not surprise anyone: The source of the problem has not been removed.

In Russian research, dietary supplements also play an important role in the therapy.³⁷⁴ More therapeutic measures as an “alternative” to reducing exposure, for example special stones and magnets and small things to attach to mobile phones etc., have – at least to me – no comprehensible scientific explanation as to how they are supposed to work. They seem largely to rely on anecdotal evidence and lofty theories. I cannot claim they are unfounded, but I find it useful to disregard them in this context.

Reducing exposure, both as to signal strength (power) and pulsation, therefore appears to be the most effective option.

It seems clear from the material presented in this document that in order to *completely* remove the potential for harm to health from AMS meter radiocommunication, the radio communication must be eliminated. Some mechanisms of damage – such as pulsing – are almost independent of the signal power – as they work through interference, not heating of tissue.

Experience shows that the biological acute ailments can be significantly weakened for many by changing some of the important characteristics – the characteristics of the *pulsation, how often pulses are sent, how often signalling takes place, as well as the power density*. Such changes could easily be implemented by remotely upgrading the meters' software, and could – at least to a large

370 For example; Carpenter, David O.: Excessive Exposure to Radiofrequency Electromagnetic Fields May Cause the Development of Electrohypersensitivity, *Alternative Therapies*, Nov/Dec 2014 Vol. 20, 6, https://www.researchgate.net/publication/269184131_Excessive_Exposure_to_Radiofrequency_Electromagnetic_Fields_May_Cause_the_Development_of_Electrohypersensitivity

371 Smart meter stories, <https://einarflydal.com/smartmaler-historier/>

372 There is a lot of specialist literature here that I have no overview of at all. Some general advice can be found in Hecht 2016, see note 79, and in EUROPAEM 2016, see note 33.

373 EUROPAEM 2016, see note 33

374 Hecht 2016, see note 79

extent – be made even without disturbing the collection of meter logs via radio. E.g., logs do not have to be transmitted each hour, as they are not processed more often than once per day. And beacon signals every 0,6 seconds, useful to track moving devices, are not needed from meters which are fixed to a wall. There is simply a lot of useless communication going on.

Perhaps also the operating concept may be ripe for a change to find biologically acceptable solutions – from a network monitored in real time (the Aidon concept) to a concept where the meters only listen and communicate when they are activated, e.g., by a signal sent from the grid provider to "wake them up".

As we see, there are compromises that might help the vast majority of those who get acute ailments, and probably reduce the health risk for the entire population over time.

Listed below are some alternatives, simple technical and practical measures that are likely to have significant impact on reducing biological harm. They will to some extent compromise the collection of management data by the utilities, but should still be able to deliver the required consumption data to the authorities:

- The meters only transmit during the day, not at night.
- The meters only transmit once per day.
- Refreshing of the local mesh network only takes place during the day, only a very few times per day, possibly only on command from the processing centre, instead of continuously and frequently as per today.
- The local mesh networks are set up by starting with weak power gradually increased to functional level (as in 3G and 4G technology), instead of starting with full power and then reducing power to level needed, as today (and in GSM).
- Signalling is changed to signalling with less abrupt characteristics.

All of the above can be done through software updates. More extensive and costly measures could be the following alternatives:

- The meters communicate locally via wired/fibre broadband instead of via radio-based mesh networks.
- The meters only transmit via UMTS, not via local mesh networks.
- Meter rooms, where many meters transmit to each other continuously over a short distance, is avoided.
- Antennas are moved to the outside of the home. Small aperture directional antennas are used.
- The meter is moved to the outside of the home, as mandatory in present building regulations (Norway: NEK 399-1:2014).³⁷⁵

Some of these solutions shift the load away from residents over to other households and closer to the surrounding environment – i.e. harming insects, birds, plants, etc. The threats from EMFs on the environment is now beginning to receive attention.³⁷⁶

In order to remove all possibilities of biological effects from the radio communication, the radio communication must be switched off completely. If not done by cable, the consumption must then be read “manually”, just as it used to be.

³⁷⁵ <http://boligprodusentene.no/nyheter/ny-nek-400-og-nek399-fra-1-januar-2015-article748-151.html> [Link no longer available. The building regulations have since been superseded.]

³⁷⁶ See the EU's EKLIPSE project's first conference on the subject of EMF and wildlife: http://www.eklipse-mechanism.eu/emr_conference

In Aidon meters, the radio communication is silenced by removing the network interface card – preferably before installation. Since it has been found that *the longer the exposure, the more severe the symptoms and the higher the sensitivity to exposure, the radio communication should be turned off completely before assembly.*

*It is an act of unacceptable ignorance to first install the meters and then see if people become ill or not, as some network companies suggest to their customers.*³⁷⁷

12.2 Dirty electricity from AMS/smart meters

“Dirty electricity” – a common label for “voltage noise” in the electrical wiring – has little mention in the debate about electromagnetic fields and the effects on health risks. Still, the topic is highly relevant in connection with AMS/smart meters, as the power supply produces dirty electricity and because PLC solutions, i.e. power line communications, are based on creating “dirty electricity”, emanating from the grid as from a 3-dimensional antenna.

There are, nevertheless, a number of studies on the topic. Reference should only be made here to a couple of popular academic reviews with extensive bibliographies.³⁷⁸ [Added 2023: For more on the topic, see: Flydal & Nordhagen, Smart meters, dirty electricity, pulses and health, 2023, <https://bit.ly/45fKV3c>]

With increased power consumption and digitalisation, we are seeing more and more disturbances in the power grid in the form of pulses. Dirty electricity can be measured as various frequencies, mostly ELFs, i.e. extra low frequencies, but still higher than the household's 50Hz waves. See the picture in Figure 41.

The problem with dirty electricity is of the same kind as the pulsation described in radio signals: Frequencies, harmonic overtones and partial overtones are formed in the electric field around wires that are not shielded. If their power is high enough, or there is “constructive interference”, signals will build up and the wire will radiate like an antenna.

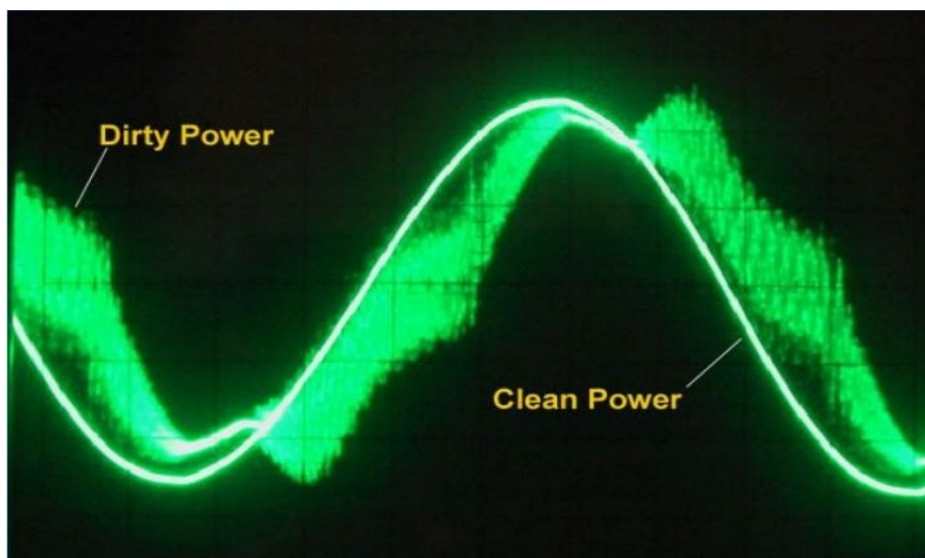


Figure 41: The shadow around the electrical current's sine curve shows harmonic fluctuations, so-called "dirty electricity" (photo: Marcel Honsbeek)

377 Letter from an electricity supplier received as a copy by e-mail about 29.5.18

378 Milham, Samuel: Dirty electricity - Electrification and the diseases of civilization, iUniverse, 2010; Firstenberg, A: The Invisible Rainbow, 2017

12.2.1 Dirty electricity from the power supply of the AMS/smart meter

Unlike the old, analogue electricity meters, digital power meters need their own power supply. A digital power supply unit is built into the meter. It draws power from the mains in quick “nips” (square pulses). Such square pulses have the same properties as other pulses, and create “noise”, or “dirty electricity” in the power grid at the level of for example; a mobile charger. Most probably, you already have many such sources of dirty electricity in your home.

Some people with EHS – there are many such cases in Norway – do regularly get acute symptoms from dirty electricity even in blinded situations, e.g. from such situations as described here: “I got a severe headache when my husband connected a mobile charger in the room next to where I was sitting – although I was not aware what he had done.” For them, even a meter without radio communication might therefore create a health problem, while the old analogue meters do not.

This problem can to some extent be dealt with on site on a case-by-case basis by installing filters close to the meter. (Such filters are commercial goods, but the type of filters must be assessed based on local conditions and measurement of values. They must be installed by professionals and are costly.)

12.2.2 AMS with PLC – communication over the mains

According to NVE, about 15% of the AMS electricity meters installed in Norway are installed with communication over the power grid (Power Line Communication). They produce dirty electricity, both from their own power supply and from their communication over the electricity network.

The health issues from PLC are the same as those with pulsed radiation from radio communication.

The solution could be the removal of the communication part, or fitting electrical filters against dirty electricity just inside the meter. (Such filters are commercial goods, but the type of filters must be assessed based on local conditions and measurement of values.)

In France, several court cases have resulted in the French power grid company EDF having to discontinue PLC for the respective EHS customers.

13. Conclusion – and hypotheses that will be answered around 2025

In the modern welfare society, we depend on public regulators for the provision of necessary infrastructure such as electricity, communication and healthcare. They should provide consumers with correct and factual information. The regulators should not allow themselves to be used in a game of hiding information, nor to run such games themselves.

As consumers, employees and private individuals, we have to live with the consequences of these regulators' actions.

Therefore, we must also scrutinise them when we suspect that they are failing in their societal role: Not only market players can fail, but also the administration that is tasked with setting the framework for them and promoting society's interests in their sector.

This document provides evidence – of the two strongest types in Karl Popper's evidence hierarchy (see Section 4.2.1) – that such a failure has occurred and is occurring in this area in connection with the introduction of AMS/smart meters in Norway. Not only consumers, but also network companies and the administration itself are among the victims – as well as those working for them.

The fact that a few thousand Norwegians have suffered acute health problems from these meters – and perhaps many more who are unaccounted for – is a tragedy by itself. Also, that will happen in all countries where this technology is rolled out. The consequences of increased microwave exposure in the general population will, according to the many and extensive Soviet Russian and Central European long-term studies, only become noticeable after around 3 to 5 years.³⁷⁹

This should mean that now in 2018 we can put forward a hypothesis that it should be possible to test in a few years:

From around 2022, there will be a tipping point in health statistics. From around 2025 it should be possible to observe that from 2022 there has been a growth in general morbidity, and the increase in morbidity will be steeper in the following 10-15 years. Some – the “electrically insensitive” – who in number are perhaps as numerous as the electrically hypersensitive – will go completely free.

The most common symptoms will be neuro-vegetative disturbances such as neuroses, depression, fatigue during the daytime, performance impairment, sleep problems, headaches, various changes in heart/vascular functions, hyperactivity, cardiac arrhythmia, tinnitus and inner restlessness.

The increase in many of these symptoms is already a topic that is constantly reported in the newspapers, while journalists leave medical experts to ponder the causes, and the thermal paradigm blocks the health sector from insight into the possible relationship to EMF exposure.

The hypothesis is thus that we will get more of such symptoms in the population, together with other symptoms or disorders that can be associated with *oxidative stress* and other well-characterised reactions to non-thermal exposure to microwave radiation.

The development of morbidity will – according to a scientific review carried out by Hecht and Balzer in 1997³⁸⁰ – proceed quite quietly (see Figure 42) following a pattern we can recognise in the findings of Hans Selye on biological stress and threshold values:³⁸¹

379 Hecht 2016 op. cit., see note 79

380 Hecht, K.; H.-U. Balzer (1997): Biological effects of electromagnetic fields in the frequency range 0 to 3 GHz on humans. Commissioned by the German Federal Institute for Telecommunications. Contract no. 4231/630402. Review of Russian research literature between 1960 and 1996.

381 See chapter 2 point 17 Cocktail effect and threshold value.

1. First, the sympathetic nervous system reacts – weakly in the vast majority of people, strongly in those who are hypersensitive to electricity (EHS).
2. The body's many systems compensate and maintain the balance (homeostasis), but
3. after some time, this biological stress situation becomes too much. Then the health problems show up – after three years or maybe fifteen or more, and with some individuals they never appear.

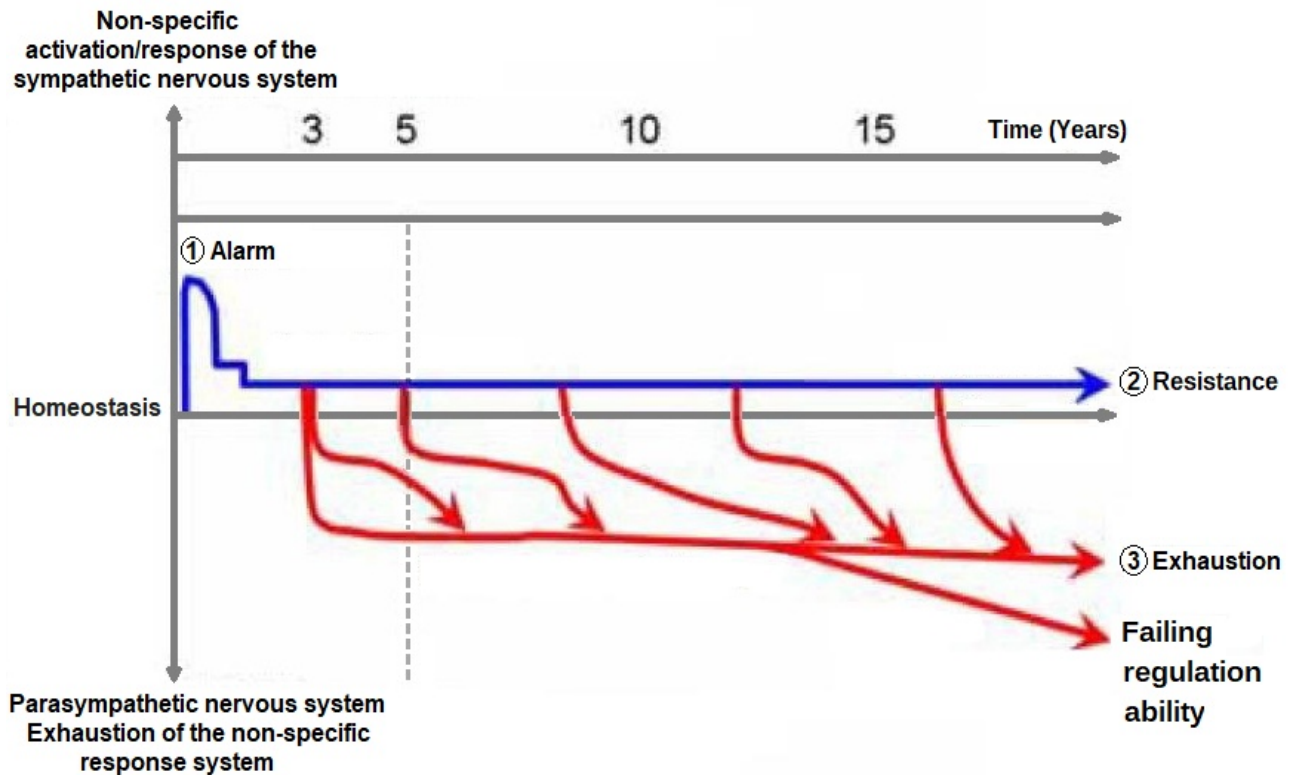


Figure 42: The course of development in the reactions to AMS/smart meters in Norway? (Hecht 2016)

Surveying the current situation and then again in 2022 and the years thereafter would give the data sets needed. Hypotheses should be formulated more precisely so that they are quantitatively testable. That part we can leave that to the professionals.

For small animals like insects and birds, which have a much faster metabolism, the theory suggests that the pattern will appear more quickly. So corresponding hypotheses can easily be formulated for them as well. To do so is urgent.

When time comes, we could then contest the claims the NVE, the power grid companies and the Norwegian Radiation Protection Authority tell us on their websites about this radiation being safe. Those pages have been collected and are stored in Dropbox and on the hard drives around in the thousands of homes, together with all written documents and the Norwegian Directorate of Health's dictum that medical doctors are not allowed to state in certificates that people may possibly become ill from wireless radio communication.

This book from 2018, translated from Norwegian, provides you with overview, explanations and valuable references to sources on electricity smart meters and health:

In its first part, **Advokatfirmaet Erling Grimstad AS**, a Norwegian law firm, provides an overview of some legal issues related to the risk of negative health effects of smart meters. The report is highly critical of the positions on the matter taken by the Norwegian governmental agencies for health and radiation protection.

In the second part, **Einar Flydal**, retired from his positions as a scientific researcher and strategy adviser at the corporate headquarter of Telenor and adjunct professor at the Norwegian University of Science and Technology (NTNU), provides a primer on the scientific knowledge about the effects on health – acute and over time – from pulsed microwaves in general and smart meters in particular. Also, he explains how today's absurdly high exposure limits came about, and the games played to create and defend them.

“The radiation from the new smart electricity meters is so weak and infrequent that it is not dangerous to your health to have one installed at home.”

Tone-Mette Sjømoen
Head of Section,
Department of Applied Radiation,
Norwegian Radiation Protection Authority (DSA)

“We know nothing about the health aspect. We're just professional engineers.”

Guro Grøtterud,
Head of Section,
End User Market, in charge of the smart meter deployment
The Norwegian Water Resources and Energy Directorate (NVE)

“The radiation from smart meters is stronger than the radiation which, when the Soviet Russians irradiated the US Embassy in Moscow for 22 years, caused a number of cancers, birth defects and other health problems.”

Jerry Flynn,
Top cleared NATO officer
Electronic warfare specialist

Fundraising in May 2018 made the juridical investigation and the publishing of this book possible.

Foreningen for EMF-reform

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