



# Scientific Facts on Electromagnetic fields from **Power lines, Wiring & Appliances**

**Source document:**  
IARC (2002)  
**Summary & Details:**  
GreenFacts

**Context** - Because electricity is so much a part of our lives, there are electromagnetic fields (EMF) around us most of the time. Overhead power lines, wiring in buildings and electrical appliances generate "Extremely Low Frequency" (ELF) electromagnetic fields. Can such ELF fields cause cancer, leukaemia or other health effects?

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This Digest is a faithful summary of the leading scientific consensus report produced in 2002 by the International Agency for Research on Cancer (IARC):  
*"Summary of Data Reported and Evaluation of Static and Extremely Low-Frequency (ELFs) Electric and Magnetic Fields"*

The full Digest is available at: <https://www.greenfacts.org/en/power-lines/>

**i** This PDF Document is the Level 1 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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## 1. What are Extremely Low Frequency electromagnetic fields?

1.1 Electromagnetic fields (EMF) are a combination of invisible electric and magnetic fields of force.

Humans are exposed to electromagnetic fields generated by natural phenomena such as the earth magnetic field or lightning, but also by human activities, including the use of power lines and electrical appliances.

1.2 Most electricity carried in powerlines, wiring and appliances is alternating current (AC). Electromagnetic fields generated by this alternating current are **Extremely Low Frequency (ELF)** fields. Not reviewed in this study, because they have higher frequencies, are for example fields from radio and television antennas, microwave ovens, cellular telephones and their antennas.

1.3 As electricity is almost everywhere, in overhead power lines, wiring in buildings and electrical appliances in our homes and at work we are almost constantly surrounded by electromagnetic fields. Both electric and magnetic fields weaken with distance away from source.

Figure on frequency ranges from different sources

## 2. What is known about exposure to Extremely Low Frequency (ELF) fields?

2.1 The exposure to electromagnetic fields can be measured using specialized instruments or estimated from other parameters.

2.2 Several theories try to explain how Extremely Low Frequency (ELF) fields could possibly produce biological effects. A well-established interaction mechanism is that currents and electric fields are induced in living tissues by ELF electric and magnetic fields, but other possibilities, which may even be more important at typical exposure levels, are also being explored.

## 3. Do Extremely Low Frequency (ELF) fields cause cancer?

3.1 The overall conclusion of the many studies available is that Extremely Low Frequency (ELF) fields do not cause cancer in laboratory animals.

3.2 Overall, studies show an increase in childhood leukaemia when children are exposed to relatively strong magnetic fields in the home. However, the evidence is considered limited because of various possible biases.

3.3 So far there is no consistent indication that ELF fields can cause cancer in adults.

3.4 Therefore, ELF magnetic fields were classified by the International Agency for Research on Cancer (IARC) as "possibly carcinogenic to humans" based on limited evidence for childhood leukaemia.

## 4. Do Extremely Low Frequency (ELF) fields cause other health effects?

4.1 On the whole, available studies do not indicate that Extremely Low Frequency (ELF) fields harm reproduction and development in animals or humans.

4.2 Most studies show no indication that ELF fields are directly harmful to genetic material. However it is possible that ELF fields enhance the effects of agents (substances, factors or situations) that are known to induce mutations or tumors.

4.3 There were many studies on laboratory animals to investigate non-cancer effects but no consistent effects were found.

4.4 Many studies on humans involved tests, which were performed on volunteers, mainly on their immune system, blood, melatonin hormone, cardiovascular and central nervous systems. Despite a few subtle and transitory effects, the overall conclusion is that there is no convincing evidence that ELF fields cause other harmful health effect at environmental exposure levels.

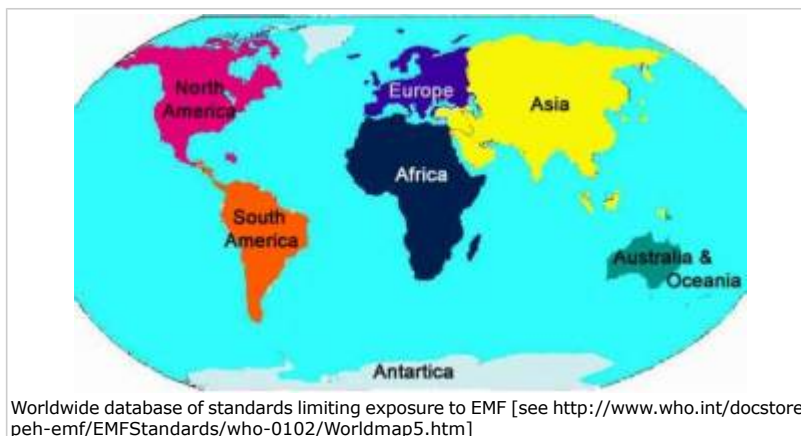
## 5. Are there standards and guidelines for ELF field exposure?

Standards in many countries are based on the same scientific data, but due to small differences in interpretation they may vary from one country to another. Most use the guidelines of the International Commission on Non-Ionizing Radiation Protection (International Commission on Non-Ionizing Radiation Protection) as the reference. The guidelines set by the ICNIRP vary for different frequency ranges. They provide protection against known adverse health effects.

International Commission on Non-Ionizing Radiation Protection guidelines (1998) are available on [www.icnirp.de/pubEMF.htm](http://www.icnirp.de/pubEMF.htm) [see <http://www.icnirp.de/pubEMF.htm>] ([www.icnirp.de/documents/emfgdl.pdf](http://www.icnirp.de/documents/emfgdl.pdf) [see <http://www.icnirp.de/documents/emfgdl.pdf>] ) - see especially pages 15 to 21 and a statement on how to use them at [www.icnirp.de/documents/use.htm](http://www.icnirp.de/documents/use.htm) [see <http://www.icnirp.de/documents/use.htm>].

For more information on these guidelines, see [www.icnirp.de/documents/philosophy.pdf](http://www.icnirp.de/documents/philosophy.pdf) [see <http://www.icnirp.de/documents/philosophy.pdf>]

The WHO International EMF Project has compiled a worldwide database of standards limiting exposure to EMF. Standards for each individual country are available at [www.who.int/docstore/peh-emf/EMFStandards/who-0102/Worldmap5.htm](http://www.who.int/docstore/peh-emf/EMFStandards/who-0102/Worldmap5.htm) [see <http://www.who.int/docstore/peh-emf/EMFStandards/who-0102/Worldmap5.htm>].



## **6. Conclusions**

ELF magnetic fields are classified by IARC as "possibly carcinogenic to humans" based on limited evidence for childhood leukaemia at relatively high exposure levels. ELF fields do not appear to cause cancer in laboratory animals or in adults (see question 3).

Overall, the many studies available do not indicate that ELF fields cause harmful non-cancer health effects, neither in animals nor in humans (see question 4).