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# Electric and Magnetic Fields

A summary of the scientific research

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## Introduction

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For more than 35 years, considerable scientific research, review and public discussion has focused on electric and magnetic fields (EMF) and health impacts. National Grid monitors and supports ongoing academic EMF research and tracks the conclusions of leading science and health organizations and government agencies around the world. We rely on these organizations for independent assessments of EMF research and consult with EMF experts to guide our understanding of this research.

In this brochure, National Grid summarizes and shares EMF information with our customers and provides resources to obtain additional information.

# What is EMF?

EMF refers to the two types of fields associated with any kind of electricity—electric fields and magnetic fields.

Electric and magnetic fields are produced by both natural and man-made sources that surround us in our daily lives. They occur throughout nature and in our own bodies. The earth itself produces a magnetic field, which is used for compass navigation.

**Electric fields** are related to voltage. Voltage that drives electricity is similar to pressure in a water pipe. Higher voltages produce stronger electric fields.

**Magnetic fields** are related to the amount of electric current that is flowing through a conductor. This is similar to the rate of fluid flow in a water pipe. Higher currents produce stronger magnetic fields.

For example, the magnetic field generated by a hair dryer is higher when the dryer is operated on its high heat setting than on the low setting because the high setting draws more current. The electric field from the hair dryer, however, will be the same at both settings because the voltage does not change.

There are other differences between electric and magnetic fields. Most conductive materials, including buildings and trees, block electric fields, but do not block magnetic fields; however power lines with multiple conductors can be designed and built to lower the magnetic fields from the lines.

The strength of electric and magnetic fields diminishes with distance from the source.

This figure of the magnetic field from common sources shows how the strength of the field drops off with distance.

## Magnetic Fields Measured from Appliances

Source	Distance from Source*		
	6 inches (mG)	1 foot (mG)	2 feet (mG)
Can Opener	600	150	20
Vacuum Cleaner	300	60	10
Hair Dryer	300	1	–
Portable Heater	100	20	4
Electric Range	30	8	2
Dishwasher	20	10	4
Toaster	10	3	–
Coffee Maker	7	–	–

Source: EMF Questions and Answers (NIEHS, 2002)

\* The numbers represent the median magnetic field (i.e., half of the appliances tested had higher levels and half had lower levels than those shown in the figure).

The focus of most scientific research on the potential health effects of EMF has been magnetic fields, and not electric fields. In the United States, magnetic fields are measured in units called milliGauss (mG). In other countries, magnetic fields are also measured in units called microTesla ( $\mu\text{T}$ ). One microTesla equals 10 milliGauss.



# Am I Exposed to EMF?

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EMF is found wherever electricity is generated, delivered, or used. Many vital things in our daily lives produce EMF: wiring in homes, workplace equipment, power lines, computers, appliances, and electric motors. Our exposure to EMF varies throughout the day depending on the sources of fields we encounter and how close we are to them. For example, EMF exposure can occur while performing activities around the house, at work, and while commuting.

## What Types of Studies Have Been Done on EMF and Health?

Three types of scientific studies are typically considered when evaluating the potential impact of an external factor like EMF on human health:

**Epidemiologic Studies** – Groups of people are evaluated to assess whether exposure to a specific chemical, therapeutic drug or environmental factor is statistically associated with the presence or absence of a specific disease. Scientists often look for evidence that people with a higher exposure to the agent are more likely to get the disease than those who have lower or no exposure to the agent.

**Laboratory Animal Studies** – Living laboratory animals are exposed to a specific agent under controlled conditions to look for changes in body function and measures of health or disease. The exposure levels used in laboratory studies are often much higher than those that would be

experienced in natural settings. Effects that are observed in laboratory animals can help predict effects that could occur in people.

**Cell and Tissue Studies** – Researchers expose individual cells or groups of cells (tissues) to a specific agent under controlled conditions. These studies often are used to investigate the mechanisms by which an exposure could affect biological processes and the tissues of the body.

No single study, or type of study, can address all questions about what may affect our health; all three types of studies must be considered together. In order to conclude that a cause-and-effect relationship exists, scientists look for consistent and strong associations in epidemiologic studies that are supported by animal and cell or tissue findings that have been replicated in different laboratories.

# What Are the Results of Recent EMF Studies?

Numerous national and international organizations responsible for health decisions have convened groups of scientists to review the EMF research published to date. No single study can address all questions, so evaluations must be based on the overall weight of scientific evidence. National Grid relies on experts to provide interpretations of the research and the science to guide our policies and operations.

The consensus of the international scientific community after more than 35 years of research is that the science has not established a causal link between exposure to EMF and risks to public health.

The following agencies have organized panels of highly respected independent scientists to review the research on EMF and health. Below are brief quotes from their research conclusions.

The National Academy of Sciences/National Research Council, 1999

“Results of the EMF RAPID program do not support the contention that the use of electricity poses a major unrecognized public health danger.”

The National Institute of Environmental Health Sciences, 2002

“Electricity is a beneficial part of our daily lives, but whenever electricity is generated, transmitted, or used, electric and magnetic fields are created... For most health outcomes, there is no evidence that EMF exposures have adverse effects.”

U.K. National Radiological Protection Board (NRPB) Report of an Advisory Group on Non-Ionizing Radiation (AGNIR), 2001

“Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general.”

International Commission on Non-Ionizing Radiation Protection (ICNIRP) Standing Committee on Epidemiology, 2001

“In the absence of experimental evidence and given the methodological uncertainties in the epidemiologic literature, there is no chronic disease for which an etiological relation to EMF can be regarded as established.”

World Health Organization (WHO), 2007

“Given the weakness of the evidence for a link between exposure to ELF [extremely low frequency] magnetic fields and childhood leukemia and the limited potential impact on public health, the benefits of exposure reduction on health are unclear and thus the cost of reducing exposure should be very low.”

International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2010

“It is the view of ICNIRP that the currently existing scientific evidence that prolonged exposure to low frequency magnetic fields is causally related with an increased risk of childhood leukemia is too weak to form the basis for exposure guidelines. In particular, if the relationship is not causal, then no benefit to health will accrue from reducing exposure.”

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), 2015

“As stated in the previous Opinions, no mechanisms have been identified and no support is existing from experimental studies that could explain these findings, which, together with shortcomings of the epidemiological studies prevent a causal interpretation.”

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# Conclusions

Overall, the conclusions of these health review panels have been similar:

- None of the panels concluded that exposure to either electric or magnetic fields causes any long-term, adverse effects on health.
- The EMF field levels found in our environment are far too low to cause nerve or muscle stimulation.
- Some epidemiologic studies have reported statistical associations between childhood leukemia and long term exposure to higher magnetic fields, while others did not. The WHO recommended conducting further research to understand what caused the small observed statistical association.
- No consistent increase in cancer has been reported in animals exposed over long periods, nor did researchers find a mechanism that would explain how magnetic fields could initiate disease at the cellular level.

## More Information and EMF Services

**National Grid** has personnel who are trained to measure EMF in customer locations and along our transmission and distribution lines. Property owners wishing to have EMF measurements taken should call National Grid's toll-free customer service line at 1-800-322-3223 in New England, or 1-800-642-4272 in New York.

Information, updates and our principles on EMF are available on the National Grid website, at [https://www.nationalgridus.com/commitment/d3-3\\_emfs.asp](https://www.nationalgridus.com/commitment/d3-3_emfs.asp)

## Additional Information

### Scientific Organizations in the US:

- National Cancer Institute (NCI) – <http://www.cancer.gov/cancertopics/factsheet/Risk/magnetic-fields>
- National Institute of Environmental Health and Safety (NIEHS) – <http://www.niehs.nih.gov/health/topics/agents/emf>

### Scientific Organizations Outside of the US:

- World Health Organization, International EMF Project – <http://www.who.int/peh-emf/about/WhatisEMF/en/>
- Canada – Health Canada – <http://healthycanadians.gc.ca/healthy-living-vie-saine/environment-environnement/home-maison/emf-cem-eng.php>
- Australia – Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) – [http://www.arpansa.gov.au/radiationprotection/factsheets/is\\_electricity.cfm](http://www.arpansa.gov.au/radiationprotection/factsheets/is_electricity.cfm)
- European Union – Scientific Committee on Emerging and Newly Identified Health Risk Opinion on Potential health effects of exposure to electromagnetic fields (EMF) – [http://ec.europa.eu/health/scientific\\_committees/emerging/docs/scenih\\_r\\_o\\_041.pdf](http://ec.europa.eu/health/scientific_committees/emerging/docs/scenih_r_o_041.pdf)
- United Kingdom – Public Health England – <https://www.gov.uk/government/publications/electric-and-magnetic-fields-health-effects-of-exposure/electric-and-magnetic-fields-assessment-of-health-risks>

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