Does EMF harm livestock, wildlife, and crops?

Similar to research on human health, a substantial number of studies have been conducted to evaluate the possible effects of EMF exposure on the health of plants, wildlife and livestock, including cattle, sheep, swine, and poultry (e.g., Malkemper et al., 2018, Pophof et al., 2023). Overall, the research reviewed does not conclude that EMF from transmission lines result in adverse effects on the health, behavior, or productivity of wild or domestic animals.

Additionally, the results of studies conducted on crops and plants exposed to EMF do not provide any reliable evidence that EMF at levels typically found under transmission lines are harmful to crop yield or production.

Does EMF interfere with pacemakers or other implanted cardiac devices?

Two of the most important classes of implanted cardiac devices are pacemakers and cardioverter defibrillators (ICDs). Both classes of devices are designed to sense and monitor the electrical activity of the heart in preparation for corrective action if necessary.

While electrical signals from outside sources (such as electric appliances, radio communication technologies, or medical equipment), may in principle interfere with the normal operation of implanted cardiac devices, the fields from most of these sources are too weak to affect the standard operation of these devices. In addition, modern implanted cardiac devices incorporate many technological and design features (including the use of a metallic casings and filters to block fields from sources in the environment to minimize the potential for interference. A European Union standard specifies that EMF levels below the 1998 ICNIRP exposure guidelines for the general public of 833 mG and 4.2 kV/m would not pose a likely risk (CENELEC EN 50527-1, 2016).

It is theoretically possible but highly unlikely for power lines to have an effect on these devices. The likelihood of an adverse impact to a pacemaker or other implanted cardiac device from power lines is extremely small given the low levels of electric and magnetic fields typically measured even directly under the line where the fields would be highest. Patients should consult with their physicians if they have concerns about the compatibility of their devices with any source of EMF.

NYSEG and RG&E provide information on EMF produced by any new or upgraded facilities or lines in applications to state agencies. That information is publicly available as part of those filings. Both companies comply with applicable environmental laws, regulations and standards and are committed to providing safe, reliable and sustainable electric service to meet the needs of our customers both today and well into the future.

More information on this topic

World Health Organization (WHO):
https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/non-ionizing/exposure-to-extremely-low-frequency-field

European Committee for Electrotechnical Standardization (CENELEC, 2016).
Procedure for the assessment of the exposure to electromagnetic fields of workers bearing active implantable medical devices - Part 1: General (EN 50527-1). Brussels, Belgium: CENELEC, 2016.

Health Canada (2022):
https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/power-lines-electrical-appliances.html

International Commission on Non-ionizing Radiation Protection (ICNIRP, 2010).
Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz). Health Phys 99: 818-36, 2010.

International Committee on Electromagnetic Safety (ICES, 2019).
IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields 0 to 300 GHz. IEEE Std C95.1-2019, Oct. 2019.

Malkemper E et al. (2018). The impacts of artificial electromagnetic radiation on wildlife (flora and fauna). Current knowledge overview: a background document to the web conference. A report of the EKLIPSE project. 2018.

Pophof B et al. (2023). Biological Effects of Electric, Magnetic, and Electromagnetic Fields from 0 to 100 MHz on Fauna and Flora: Workshop Report. Health Phys 124 (1):39-52, 2023.

Scientific Committee on Health, Environmental and Emerging Risks (SCHEER, 2024):
https://health.ec.europa.eu/document/download/85ef39d5-49dc-4b5a-b875-54e578d1d2bc_en?filename=scheer_o_063.pdf

New York State Public Service Commission (NYPSC). Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities. Cases 26529 and 26559 Proceeding on Motion of the Commission. Issued and Effective: September 11, 1990.

U.S. National Institute for Environmental and Health Sciences (NIEHS, 2002):
https://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf World Health Organization (WHO, 2016): https://www.who.int/news-room/questions-and-answers/item/radiation-electromagnetic-fields

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This brochure was prepared by Exponent®, a scientific and engineering firm, to present a current summary of the status of EMF research as reflected in reviews by national and international science and health organizations. This brochure is limited to the scientific literature reviewed and may not include all information in the public domain.

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Electric and magnetic fields

What is an EMF (electric and magnetic field)?

EMF refers to electric and magnetic fields. Natural sources of EMF include the earth's static 0 hertz (Hz), magnetic field, which we use for compass navigation, and the oscillating alternating current (AC) electric and magnetic fields occurring within our own bodies as a result of the normal electrical activity of our nerves, brain and heart. Most of the electricity we use daily is another source of AC fields. The frequency of EMF that is produced by most everything connected to our electrical system is 60 Hertz (Hz); these fields are commonly referred to as extremely-low-frequency (ELF) EMF.

Electric fields result from the electric charge (or voltage) applied to electrical conductors and equipment and are measured in units of volts per meter (V/m) or kilovolts per meter (kV/m). Magnetic fields are produced by the movement of electricity (or current) such as through a wire. Magnetic field levels are measured as magnetic flux density in units of gauss (G) or milligauss (mG).

Both electric fields and magnetic fields diminish quickly in strength as distance from the source increases. Electric fields are easily blocked by grounded conductive objects such as buildings, walls, trees, and fences while magnetic fields are not easily blocked by most everyday objects. As a result, most research on EMF and human health has focused on exposure to magnetic fields.

Common sources of EMF in our homes

Because electricity powers so many devices, magnetic fields are present throughout our daily lives while at home, work, school, out shopping, during travel, and other places. Our daily exposure depends on where we spend time and the sources we encounter in those locations.

Indoors, the primary sources of magnetic fields in most homes are the electrical wiring in buildings and the electrical appliances and equipment we use. The highest magnetic-field levels are typically found close to operating appliances; for example, as shown in Table 1, magnetic-field levels can reach several hundreds of mG when six inches from an appliance.

Other residential magnetic field sources outside buildings include nearby transmission and distribution lines and currents on water pipes. Magnetic-field levels from all of these sources diminish quickly with distance, with the quickest being appliances.

Table 1.
Magnetic field levels* (in mG) measured near household appliances

	Distance from source exposure		
Source	**6 inches**	**1 foot**	**2 feet**
Hair dryer	300	1	—
Electric shaver	100	20	—
Blender	70	10	2
Can opener	600	150	20
Toaster	10	3	—
Vacuum cleaner	300	60	10
Power saw	200	40	5

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

Source: Electric and Magnetic Fields Associated with the Use of Electric Power, National Institute of Environmental Health Sciences (NIEHS) and National Institutes of Health, June 2002.

Research on EMF and human health

Research on the possible health effects of EMF exposure has been on-going since the late 1970s. Scientists around the world have conducted thousands of studies that have looked for relationships between EMF in our homes and workplaces and possible adverse health outcomes. This research includes studies that observe human populations and characteristics about their lives (called epidemiological studies), as well as studies of biological processes in animals and in cells and tissues.

The large body of research on EMF has been evaluated by numerous international health and scientific organizations, including the World Health Organization (WHO), the U.S. National Institute of Environmental Health Sciences (NIEHS), and the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). These organizations have assembled panels of scientists with multidisciplinary expertise to review the scientific research and arrive at conclusions about the possible risks associated with EMF. The scientific panels weigh the strengths and weaknesses of each individual study and consider all the evidence together when developing their overall evaluations and recommendations.

To date, none of the health and scientific agencies that have comprehensively reviewed the research have concluded that either short or long-term exposures to EMF at the levels commonly encountered in our environment— including from transmission lines— are a cause of any adverse health effects in humans or animals. The **WHO,** which in 2007 released one of the most extensive reviews of EMF health research ever conducted, concluded that the research does not establish that exposure to EMF causes or contributes to any disease or illness, including cancer. More recent comprehensive reports by SCHEER in 2015 and 2024 are consistent with the WHO and other agencies.

While an association between magnetic fields at high average long-term exposure and childhood leukemia has been reported in some studies, the role of chance, bias (i.e., errors in the studies), and confounding (when two things seem linked but another, unrelated factor is influencing both) could not be excluded as explanations for this association. Further, this association is not supported by laboratory studies or any known mechanism of action, and no health or scientific agency has concluded that this association reflects a causal relationship.

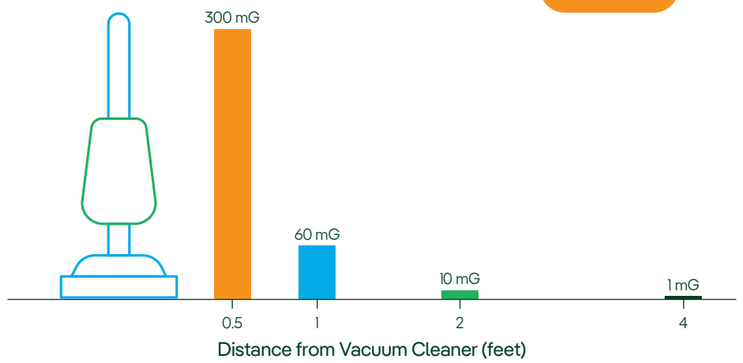
The WHO's website states:

"Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health."

"Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals."

https://www.who.int/news-room/questions-and-answers/item/radiation-electromagnetic-fields

Figure 1.
Magnetic fields decrease as distance increases



EMF Exposure Standards and Guidelines

State of New York

NYSEG and RG&E provide information on EMF produced by any new or upgraded facilities which are regulated by the Public Service Commission (PSC). This information is submitted along with applicable project filings and is publicly available as part of those filings.

International Guidelines

Two international scientific organizations have published guidelines for limiting exposure to EMF based on their review of the scientific evidence regarding potential effects of exposure. These guideline limits were set to prevent the only known and established health effects of exposure, which are short-term effects, such as stimulation of nerves and muscles and annoyance by spark discharges, that occur at high levels of exposure.

Both organizations determined that the scientific evidence does not establish a causal relationship with long-term health effects, including cancer or other diseases. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) recommends exposure limits for the general public of 2,000 mG for magnetic fields and 4.2 kV/m for electric fields. The International Committee for Electromagnetic Safety (ICES) recommends limits for the general public of 9,040 mG for magnetic fields and 5 kV/m for electric fields (10 kV/m on transmission line rights-of-way).

Impact of Power Lines on Residential EMF Exposure

The magnetic field levels associated with transmission and distribution lines vary substantially depending on the voltage, the design of the lines, and the distance from the lines. However, the strength of magnetic fields diminishes quickly with distance from the transmission line for all typical designs; therefore, the contribution of transmission lines to magnetic field levels within residences and other buildings is generally low. Examples of magnetic-field levels for transmission lines of different voltages are summarized in Table 2. Magnetic-field levels from underground cables generally diminish more quickly with distance from the lines compared to those from overhead transmission lines.

Because electric fields can be blocked by nearby conductive grounded objects like trees, fences, and walls, distribution and transmission lines usually have little effect on levels of electric fields inside nearby homes. Underground cables do not produce electric fields above ground because electric fields are blocked by the cables' sheaths and the soil covering the cables.

Table 2.
Typical Magnetic field levels (in mG) for electric transmission lines

	Under Structure	Edge of ROW*	100 feet	200 feet
115 kV	30	7	2	0.4
230 kV	58	20	7	2
500 kV	87	30	13	3

Source: Electric and Magnetic Fields Associated with the Use of Electric Power, National Institute of Environmental Health Sciences (NIEHS) and National Institutes of Health, June 2002

* Typical distance to the edge of right-of-way (ROW) is 50 feet for 115-kV and 230-kV lines and 65 feet for 500-kV lines.