

EMFIS®

Response to the U.S. Department of Health and Human Services

Request for Information on Electromagnetic Fields, high-frequency Radiation, and Wireless Radiation Exposure

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Executive Summary

EMFIS® welcomes the opportunity to respond to the U.S. Department of Health and Human Services’ Request for Information concerning high-frequency and electromagnetic-field exposure and human health.

EMFIS® is a Swiss-developed, internationally applicable, science-based rating and certification framework for low-EMF buildings and communities. Its work addresses the assessment and reduction of unnecessary electromagnetic exposure in residential, educational, commercial, hospitality, healthcare, and other occupied environments. The EMFIS® methodology incorporates building design, source management, exposure measurements, shielding, mitigation, and post-construction verification.

EMFIS® recommends that HHS consider not only maximum exposure at a single source, but also the characteristics of real indoor environments. These include simultaneous exposure to multiple frequencies, duration and recurrence of exposure, source proximity, modulation, duty cycle, reflections from building materials, spatial variability, and cumulative exposure over time.

Questions addressed. EMFIS® focuses primarily on HHS Questions 5(o) and 5(p), concerning research on exposure-minimization procedures and the exposure characteristics a classification system should capture; Questions 7–9, concerning measurement methods, improvements for real-world exposure assessment, and disclosure; Questions 12–15, concerning evidence below current limits, cumulative exposure from connected technologies, environmental effects, and wireless infrastructure; Questions 16–17, concerning federal research priorities and interagency coordination; and Question 18, inviting additional technical recommendations. The response also provides EMFIS®’s organizational perspective under Question 2. It does not offer clinical case reports or personal-health testimony under Questions 3–4.

Scientific Scope and Evidence Statement

This submission is provided by EMFIS® Electromagnetic Field International Standard as a technical contribution to the U.S. Department of Health and Human Services Request for Information on Electromagnetic Fields (EMFs), Radiofrequency (RF) Radiation, and Wireless Radiation Exposure. It is intended to support scientific discussion, exposure assessment, building-performance research, and future research prioritization.

This submission should not be interpreted as medical advice, clinical guidance, legal advice, or a determination of causality regarding any specific health outcome. The scientific literature relating to RF and EMF exposure is extensive, heterogeneous, and subject to ongoing scientific debate. References cited in this submission include epidemiological studies, laboratory experiments, animal studies, mechanistic investigations, occupational-exposure research, environmental studies, building-science publications, governmental reviews, and policy documents. Inclusion of a publication does not imply that EMFIS® endorses every conclusion reached by its authors.

EMFIS® encourages evaluation of all evidence through a transparent weight-of-evidence approach that considers study design, exposure characterization, replication, consistency of findings, biological plausibility, limitations, uncertainty, and relevance to real-world exposure conditions.

Several sections of this submission discuss ongoing EMFIS® research initiatives, including EMFIS® Certified Space Reverberation. Any descriptions of ongoing or future research are intended solely to describe the scope and objectives of those initiatives and should not be interpreted as published findings unless explicitly referenced as such.

Scientific Evidence Relevant to the HHS Review

HHS RFI questions addressed: Questions 5, 6, 12–15, and 18.

International Assessments and Scientific Reviews

The International Agency for Research on Cancer classified high-frequency electromagnetic fields as “possibly carcinogenic to humans,” Group 2B, in 2011. EMFIS® recommends that this classification and the underlying IARC monograph remain part of the federal evidence review.

The WHO’s position, as presented in the EMFIS® scientific resources, is that research has not conclusively established adverse health effects from low-level EMF exposure, while further research remains necessary, particularly in relation to long-term exposure. This combination of scientific uncertainty, rapidly changing technology, and widespread population exposure supports continued investigation rather than premature closure of the issue.

Other relevant frameworks include:

- The EUROPAEM EMF Guideline 2016.
- Council of Europe Resolution 1815.
- The European Commission SCENIHR assessment.
- Swiss federal publications on Wi-Fi, mobile phones, and radiofrequency exposure:
 - [Fact sheet WLAN](#) (Federal Office of Public Health, 1 May 2025), which summarizes WLAN emissions, measured exposure relative to limits, the health-evidence assessment, measurement limitations, and optional exposure-reduction practices.
 - [Fact sheet Mobile Phone](#) (Federal Office of Public Health, 1 June 2026), which explains SAR, proximity and connectivity effects, uncertainty concerning long-term use, and practical exposure-reduction advice.
 - [Mobile Communications and Radiation](#) (UVEK Working Group, 18 November 2019), a federal multi-stakeholder report addressing 5G technology, exposure, health evidence, regulation, policy options, and accompanying measures.

- [*Electromagnetic Fields in the Frequency Range 5.8–200 GHz: Biological Effects and Consequences for Health*](#) (report commissioned by the Federal Office for the Environment, May 2025), reviewing recent animal, human-participant, and cellular studies across eight health-related domains.
- [*Federal Office for the Environment—Electrosmog Studies*](#), the official index of commissioned research reports, including national non-ionizing-radiation exposure-monitoring reports for 2022–2024.
- The nineteenth report of the Swedish Radiation Safety Authority’s Scientific Council on Electromagnetic Fields.

These sources do not all reach identical conclusions. HHS should explicitly document areas of agreement, disagreement, and continuing uncertainty, with attention to differences in exposure definitions, endpoints, study design, and evidentiary standards.

The EMFIS® Exposure Standard, Response to Question 5(n)

EMFIS® recommends that federal health agencies consider indoor exposure benchmarks that integrate the research, guidance, and regulatory approaches of the national and international authorities discussed above with practical experience from on-site measurements in occupied buildings. EMFIS® was established because no comprehensive framework then existed that combined protective, measurable, and practically achievable exposure limits specifically for indoor environments. The EMFIS® exposure limits were developed through this combined approach: reviewing established scientific and technical frameworks, such as Baubiologie SBM 2015 and EuropaEM, evaluating field-measurement data, and focusing on values that can be distinguished reliably from the measurement system’s noise threshold. This approach supports protective targets that are technically measurable and realistically implementable in places where people spend meaningful periods of time, including homes, schools, workplaces, healthcare facilities, and hospitality settings.

In EMFIS®’s view, this building-centered approach can improve federal assessment and disclosure by supplementing source-specific compliance limits with transparent measurements of actual indoor conditions. Such assessments should document relevant frequencies, typical and peak levels, source locations, operating conditions, measurement methods, instrument sensitivity, the applicable noise threshold, uncertainty, and the cumulative contribution of multiple sources. Regulatory frameworks should also encourage practical exposure reduction through source management, distance, wired alternatives, system optimization, shielding where appropriate, and post-intervention verification.

EMFIS® believes that its exposure limits provide the most suitable framework for indoor environments because they combine precautionary protection, technical measurability, and practical feasibility. This position should be evaluated through independent comparison, transparent validation, and continued research. We therefore encourage federal agencies to examine the EMFIS® limits and assessment methodology as a potential model for voluntary indoor guidance, building-level disclosure, standardized measurement protocols, and future research.

Environmental Health Trust

EMFIS® encourages HHS to review relevant scientific, policy, and educational materials assembled by the Environmental Health Trust (EHT). EHT describes itself as a 501(c)(3) nonprofit focused on environmental-health research, policy advice and support, and public education concerning emerging environmental hazards and their effects on humans and other living organisms. Its stated activities include clinical and engineering research, independent research data for policymakers, expert input concerning radiation exposure, public-health resources, and policy engagement. These materials should be evaluated according to the same standards applied to all evidence, with clear distinctions among peer-reviewed research, policy advocacy, education, and organizational interpretation.

RWTH Aachen University EMF-Portal

A complementary research resource is the [EMF-Portal](#), operated by the femu working group at the Institute for Occupational, Social and Environmental Medicine of University Hospital RWTH Aachen. The portal states: “The internet information platform EMF-Portal of the RWTH Aachen University summarizes systematically scientific research data on the effects of electromagnetic fields (EMF).” It provides an English- and German-language literature database, individual study summaries, study overviews, information on exposure sources, a glossary, and collections of laws,

recommendations, and guidelines. HHS may use this university-based portal as a structured literature-discovery resource while reviewing the original publications and formal evidence assessments directly.

MedNIS: Independent Swiss Medical and Research Initiative

MedNIS is an independent Swiss initiative established in 2023 and coordinated by the Institute of Family Medicine at the University of Fribourg under a mandate from the Swiss Federal Office for the Environment. Its principal objectives are to improve medical care for people reporting symptoms associated with electromagnetic-field exposure, strengthen scientific knowledge through data collection, and improve information available to physicians, affected people, and the general public.

MedNIS operates a Swiss network of medical advisers to whom treating physicians may refer patients for specialized consultation. Its approach includes detailed medical history, assessment of other possible contributors to symptoms, recommendations for further examinations or treatment where appropriate, and a consultation report returned to the treating physician. MedNIS notes that no validated diagnostic criteria currently exist for electromagnetic hypersensitivity; its clinical work therefore focuses on careful assessment and improved care rather than assuming a proven causal relationship.

Since 2023, MedNIS has also conducted the Swiss Study on Electromagnetic Fields and Health to better understand the experiences and suffering of people reporting symptoms associated with electromagnetic exposure. Its first phase collected questionnaire information concerning health status, perceived exposure, symptom impacts, and measures taken for relief. MedNIS reports preliminary analyses based on 442 individuals, with final participation slightly exceeding 500; final data remain under analysis, and results are intended for open-access scientific publication. A follow-up phase examines symptoms, quality of life, reported triggers and sources, mitigation measures, interactions with healthcare, and factors associated with the condition. For this HHS response, MedNIS is cited solely as an independent example relevant to Questions 3–4, 10–12, 16, and 18—not as an EMFIS® partner or as evidence supporting EMFIS® certification claims.

ETAIN: Exposure Assessment, Citizen Science, and Planetary Health

ETAIN is a multidisciplinary Horizon Europe project. Its consortium brings together universities, research institutes, technology and citizen-engagement organizations across Europe. ETAIN develops and validates methods for assessing high-frequency electromagnetic-field exposure from existing and emerging wireless technologies, while studying practical exposure-reduction options and potential implications for human health, biodiversity, ecosystems, and policy.

Exposure tools and citizen science. ETAIN’s open-access 5G Scientist app uses mobile-network and Wi-Fi signal-quality information, together with calibration functions, to estimate environmental exposure and the handset’s output power. Aggregated observations contribute to European exposure maps, while a Dose Calculator helps users estimate exposure associated with their device-use patterns. ETAIN expressly notes that individual smartphone measurements have high uncertainty and that smartphones do not capture every source; the value of the approach lies in calibrated methods, transparent limitations, and the accumulation of observations across users, places, and times.

Human-health research. ETAIN investigates longer-term effects on the skin and eyes as key biological targets. Its work examines temperature and thermoregulation, reactive oxygen species, DNA-damage response, apoptosis, extracellular-matrix changes, inflammation, gene expression, and molecular profiles using advanced methods including transcriptomics, metabolomics, and three-dimensional human-skin models. The aim is to test whether causal links exist under defined exposure conditions rather than presume an effect.

Biodiversity and ecosystem research. The project studies insects and pollinators through laboratory experiments, field studies, controlled exposure infrastructure, and three-dimensional electromagnetic models. Research includes fruit flies across generations, honeybees, solitary bees, blue bottle flies, and longitudinal insect monitoring. ETAIN uses this work to investigate absorption, behavior, development, fitness, and possible thermal or non-thermal effects, while framing findings cautiously and distinguishing preliminary observations from confirmed ecological effects.

Exposure reduction and policy relevance. ETAIN evaluates emerging exposure-reduction techniques and “ALARA by design” approaches intended to help network operators and equipment designers balance connectivity and data

demand with lower exposure. It is also developing a planetary-health impact framework that integrates human-health, biodiversity, ecosystem, and indirect societal considerations. Its publicly available deliverables include a spot-measurement protocol for calibrating exposure estimates against smartphone-received signal quality and emitted power.

ETAIN is directly relevant to HHS Questions 5(o)–5(p), 7–8, 13–17, and 18. It offers a model for combining exposure characterization, personal-dose estimation, citizen science, controlled biological studies, ecological assessment, exposure reduction, open data, and stakeholder participation. The Swiss Tropical and Public Health Institute leads work concerning the exposure application and portal; HHS may therefore wish to examine both ETAIN’s scientific outputs and its methods for communicating uncertainty and enabling public participation.

Cancer-Related Evidence

EMFIS® recommends that HHS evaluate cancer-related evidence across human observational research, laboratory studies, animal studies, and mechanistic research rather than relying on a single evidence category.

Relevant literature identified in the EMFIS® research collection includes:

- Hardell et al., Evidence for Brain Tumors and Acoustic Neuromas.
- Hardell, World Health Organization, high-frequency radiation and health: A hard nut to crack.
- Sage, Evidence for Breast Cancer Promotion.
- Ouadah et al., concerning high-frequency electromagnetic-field exposure and C6 brain tumors in Wistar rats.
- The WHO/IARC classification and monograph on high-frequency electromagnetic fields.
- Mevissen et al., a systematic review of high-frequency electromagnetic-field exposure and cancer in laboratory animal studies.

Because these publications differ in design, exposure conditions, and evidentiary weight, EMFIS® does not suggest that they should be treated as interchangeable. They should instead be assessed through a transparent weight-of-evidence framework that considers exposure characterization, replication, bias, consistency, and biological plausibility.

Neurological and Cognitive Research

The HHS review should address neurological outcomes and possible mechanisms affecting the central nervous system, particularly in relation to chronic exposure and younger populations.

Relevant studies and reviews include:

- Kim et al., Possible Effects of high-frequency Electromagnetic Field Exposure on Central Nerve System.
- Jiang et al., on long-term electromagnetic-pulse exposure, oxidative stress, amyloid-beta deposition, and cognitive dysfunction.
- Grigoriev and Khorseva, reviewing cellular-communication electromagnetic fields as possible risk factors for the central nervous system of children and adolescents.
- Yavaş et al., examining short-term mobile-phone-related electromagnetic fields and alpha and beta brain-wave activity.

These studies support further investigation of neurophysiological and cognitive endpoints, but their individual findings should be interpreted according to their study designs and exposure conditions.

Oxidative Stress, Mitochondrial Function, and Cellular Mechanisms

Several studies in the EMFIS® research collection address mechanisms through which electromagnetic fields may interact with biological systems.

These include:

- Lopez-Martin et al., on redox cell signaling associated with black carbon and/or high-frequency electromagnetic fields.

- Lai and Levitt, reviewing cellular and molecular effects of non-ionizing electromagnetic fields.
- Sharpe et al., concerning rotating magnetic fields, mitochondrial respiration, oxidative stress, and mitochondrial integrity in cancer cells.
- Savchenko et al., examining myocardial mitochondrial oxidative phosphorylation under prolonged electromagnetic stress.
- Ito et al., reporting effects of extremely low-frequency electromagnetic fields on mitochondrial energy production in NARP cybrids.
- Ma et al., concerning calcium-mediated cell fate, including osteogenesis, chondrogenesis, and apoptosis.
- Jiang et al., examining oxidative stress in connection with cognitive outcomes.

Mechanistic evidence does not by itself demonstrate a population-level adverse health outcome. It may, however, help identify plausible pathways, relevant biomarkers, and priorities for controlled replication.

Cardiovascular, Reproductive, and Developmental Research

Cardiovascular Research

Relevant cardiovascular literature identified by EMFIS® includes:

- Parizek et al., Electromagnetic Fields: Do They Pose a Cardiovascular Risk?
- Wang et al., Electromagnetic field and cardiovascular diseases: A state-of-the-art review of diagnostic, therapeutic, and predictive values.
- Savchenko et al., examining mitochondrial oxidative phosphorylation in myocardial tissue under prolonged electromagnetic stress.

The literature also indicates that electromagnetic fields have therapeutic and diagnostic applications. HHS should therefore distinguish carefully between environmental exposure, occupational exposure, controlled clinical exposure, and intentionally applied therapeutic fields.

Reproductive and Developmental Research

The EMFIS® research collection includes literature concerning reproductive and developmental endpoints:

- Jaffar et al., Adverse Effects of Wi-Fi Radiation on Male Reproductive System: A Systematic Review.
- Siti et al., addressing the same subject in a systematic review.
- Khayat et al., examining prenatal mobile-phone radiation exposure, MMP9 expression, inflammation, oxidative stress, and sensory-motor impairment following neonatal hypoxia-ischemia in rats.
- Xu et al., concerning health effects among reproductive-age female operators of plastic-welding machines.

HHS should distinguish occupational studies, animal experiments, and environmental high-frequency exposure studies. Nevertheless, these publications identify reproductive and developmental endpoints that warrant careful evaluation and, where appropriate, additional research.

Why Low- and High-Frequency Electromagnetic Fields Should Be Tied Together

The RFI should not focus exclusively on wireless high-frequency exposure. Occupants of modern buildings also experience sustained low-frequency electric and magnetic fields associated with electrical wiring, transformers, substations, equipment, power corridors, and other components of the electricity system.

The U.S. regulatory position requires careful description. Federal agencies conduct research, provide information, regulate parts of the electricity and device sectors, and maintain nationwide requirements for high-frequency transmitters. However, EPA states that there are no U.S. federal standards limiting residential or occupational exposure to electric and magnetic fields from power lines, and OSHA states that it has no specific standard addressing ELF fields. This is therefore not an area handled only by the states in every respect; rather, the principal gap is the absence of a generally applicable federal exposure limit for power-frequency fields.

- Some states have adopted transmission-line field standards, siting policies, right-of-way criteria, measurement requirements, or low-cost mitigation approaches.
- State public-utility and siting authorities can account for local grid design, land use, building practice, population density, and community priorities.
- Different state approaches can function as policy laboratories, permitting comparison of measurement methods, disclosure practices, precautionary design measures, and mitigation strategies.
- This flexibility is most valuable when state programs publish clear definitions, measurement protocols, assumptions, uncertainties, and evaluation results.

EMFIS® considers this federal-state structure potentially constructive. In the absence of a single federal exposure limit, states have room to test proportionate approaches and choose different paths as evidence and local conditions warrant. Diversity should not, however, become opacity or inconsistent public protection. Residents, workers, designers, utilities, and local authorities should receive accessible information about field sources, measurement units, typical and maximum conditions, uncertainty, practical exposure-reduction options, and the distinction between precautionary policy and established evidence of harm. Federal agencies can support this state-level experimentation through coordinated research, common measurement terminology, interoperable data, and transparent public-health communication without prematurely imposing a single nationwide policy.

Children and Potentially Sensitive Populations

Specific RFI alignment: Question 11: whether risk evaluation should differ for children and other potentially sensitive populations.

Children merit focused study because their exposure circumstances, use patterns, and developmental stage may differ from those of adults.

The EMFIS® resources identify:

- Grigoriev and Khorseva’s review concerning children, adolescents, electroencephalography, and sensorimotor reactions.
- Research concerning the possible underestimation of absorbed mobile-phone radiation, especially in children.
- Prenatal exposure research by Khayat et al.
- EUROPAEM material concerning clinical assessment and EMF-related health concerns.

Priority settings should include homes, schools, childcare facilities, healthcare environments, and other places where children may spend substantial periods of time.

Buildings as Exposure Environments

HHS RFI questions addressed: Questions 8, 13, 15, and 18.

People encounter electromagnetic fields within physical spaces whose geometry, materials, electrical systems, wireless devices, and external infrastructure influence exposure.

The study by Awada et al., Ten questions concerning occupant health in buildings during normal operations and extreme events including the COVID-19 pandemic, provides broader context for considering occupant health as a building-performance issue. The EMFIS® references also include building-health, biophilic-design, and healthy-building literature. These wider sources are not direct evidence of high-frequency EMF health effects, but they support an integrated approach to indoor environmental quality.

Clegg et al., Building science and high-frequency radiation: What makes smart and healthy buildings, is particularly pertinent to the relationship between wireless technology, building science, and occupant exposure.

EMFIS® recommends that HHS consider buildings as dynamic exposure environments rather than treating each emitting device in isolation.

Relevant characteristics include:

- Indoor and outdoor sources.
- Distance and orientation relative to occupants.
- Building geometry.
- Reflection, absorption, and transmission through materials.
- Simultaneous operation of multiple devices and systems.
- Duty cycle and occupancy patterns.
- Fixed and mobile sources.
- Exposure variability between rooms and locations.
- Electrical wiring and power-frequency fields.
- Smart-home, IoT, and building-automation infrastructure.
- Changes in systems and equipment during the building lifecycle.

Exposure Assessment, Inflammation, and Public-Health Surveillance

HHS RFI questions addressed: Questions 5(p), 7–10, 12, and 16.

The most important mechanistic issue for this section is whether repeated or sustained electromagnetic exposure can contribute to inflammatory signaling under real-world conditions. Inflammation is relevant because it connects cellular stress responses with neurological, cardiovascular, metabolic, reproductive, and immune-system outcomes. It is not, however, established that ordinary environmental exposure causes chronic inflammatory disease in humans; the evidence is strongest in experimental cell and animal studies, while human evidence and independent replication remain limited.

A frequently proposed pathway begins with altered production or regulation of reactive oxygen and nitrogen species. When these reactive molecules exceed antioxidant defenses, oxidative stress can affect lipids, proteins, DNA, mitochondrial function, calcium signaling, and redox-sensitive pathways that regulate inflammatory responses. Reviews of experimental research report that many animal and cell studies observed oxidative-stress changes after high-frequency or extremely low-frequency exposure. Because oxidative stress and inflammation influence one another, persistent or repeated redox disturbance could plausibly alter cytokine production, immune-cell activity, tissue repair, or neuroimmune signaling. Plausibility is not proof of harm: findings vary with frequency, intensity, modulation, exposure duration, temperature control, biological model, dosimetry, and study quality.

- Inflammatory cytokines and mediators, including interleukin-1 β , interleukin-6, tumor necrosis factor- α , and C-reactive protein where appropriate.

- Oxidative-stress and antioxidant markers, including reactive oxygen species, lipid peroxidation, glutathione status, superoxide dismutase, catalase, and oxidative DNA-damage indicators.
- Immune and neuroimmune endpoints, including microglial activation, leukocyte profiles, and inflammatory-pathway activity.
- Mitochondrial function, calcium signaling, apoptosis, extracellular-matrix changes, and gene-expression responses.
- Frequency, electric- and magnetic-field strength, power density, specific absorption rate where applicable, modulation, pulses, duty cycle, beamforming, distance, orientation, and simultaneous frequencies.
- Duration, recurrence, cumulative exposure, measurement height and location, thermal conditions, sham controls, blinding, calibration, uncertainty, and potential confounders.

The evidence must be interpreted by exposure type. Deliberately applied pulsed electromagnetic fields are used clinically in some contexts and may suppress selected inflammatory pathways; those therapeutic protocols are not equivalent to uncontrolled environmental exposure. Conversely, experimental reports of oxidative or inflammatory change cannot automatically be translated into human disease risk. Recent systematic evidence concerning high-frequency exposure and neuroimmune outcomes found that most studies reported no significant effects at guideline-compliant levels, while a minority reported small or transient changes and methodological heterogeneity limited confidence. HHS should therefore avoid both assuming safety from absence of proof and inferring disease from isolated biomarker changes.

HHS should make inflammation a priority endpoint within standardized, independently replicated exposure studies. Research should combine rigorous dosimetry with repeated biomarker measurements, sham exposure, thermal monitoring, preregistered analysis, adequate sample sizes, blinded outcome assessment, and transparent reporting of null as well as positive findings. Longitudinal human studies should examine whether measured exposure precedes persistent inflammatory change after accounting for infection, obesity, smoking, medication, psychosocial stress, sleep, air pollution, and other major determinants of inflammation. This framework would clarify whether reported biological responses are adaptive, transient, reproducible, clinically meaningful, or unrelated to exposure.

The EMFIS® Certification Framework

EMFIS® was created to provide building owners, architects, engineers, developers, operators, policymakers, and the general public with a practical and measurable framework for understanding and managing electromagnetic exposure within the built environment. Originating in Switzerland, the framework was developed in response to the rapid expansion of wireless technologies, smart buildings, IoT devices, and increasingly connected living environments. The objective is not to eliminate technology, but to encourage informed design choices that allow connectivity, functionality, sustainability, and occupant well-being to coexist.

The EMFIS® framework assesses factors including external high-frequency sources, internal wireless systems, electrical infrastructure, low-frequency magnetic fields, shielding effectiveness, building materials, measurement verification, and occupant exposure conditions. Through independent assessment and certification, EMFIS® seeks to improve transparency regarding electromagnetic environmental quality while encouraging best practices throughout the lifecycle of a building.

Importantly, EMFIS® is not intended solely for individuals who identify as electromagnetically sensitive. The framework was developed for the broader population. Just as modern buildings are evaluated for air quality, water quality, thermal comfort, acoustics, daylight access, and energy performance, EMFIS® aims to establish voluntary best practices relating to electromagnetic environmental quality that can benefit entire populations. The goal is to encourage healthier, more informed, and more resilient indoor environments for everyone.

EMFIS® ultimately seeks to empower the public through transparency, encourage healthy-building innovation, support evidence-based design, foster scientific research, and advance practical approaches to understanding and managing electromagnetic exposure in the built environment.

Certification Levels and Progressive Improvement

EMFIS® recognizes that buildings are delivered under diverse technical, economic, operational, and regulatory constraints. Its certification framework therefore uses defined assessment criteria through which projects earn points for implementing and verifying measures that improve electromagnetic environmental quality. The total number of points achieved determines whether a project reaches one of three certification thresholds: Bronze, Silver, or Gold. Each successive level reflects broader implementation of the criteria and stronger verified performance, while allowing projects to pursue improvement within their practical constraints.

EMFIS® has developed a suite of internal protocols to make on-site assessments repeatable, documented, and adaptable to different building types, project stages, source conditions, and technical objectives. The assessment is not limited to a single spot reading. It combines a review of the building and its systems with structured measurements under recorded operating conditions. The scope is defined before the visit according to the certification criteria being evaluated, the areas occupied, the known or suspected sources, and any planned mitigation measures.

The EMFIS® certification levels provide a transparent and independently verifiable method for communicating a building's electromagnetic performance to occupants, owners, developers, investors, and public authorities, much in the same way that sustainability, energy-efficiency, and wellness certifications communicate broader environmental performance.

By making certification attainable across multiple achievement levels, EMFIS® seeks to promote widespread adoption of better practices rather than limiting low-EMF design to a small number of specialist developments. Project teams can progressively improve electromagnetic environmental quality while balancing connectivity requirements, operational needs, financial constraints, and occupant expectations.

From a research perspective, the tiered framework also provides an opportunity to compare exposure characteristics, building strategies, and mitigation approaches across different certification levels. As adoption expands, the framework may facilitate the development of valuable real-world datasets that support further research into exposure patterns and building performance.

EMFIS® Certified Space Reverberation Field Research

HHS RFI questions addressed: Questions 5(o), 7–8, 13, 16, and 18.

EMFIS® has developed an exploratory, repeatable on-site protocol to test whether partial HF shielding materially changes real-life high-frequency power-density patterns when wireless devices operate inside a protected residential space. The work is an engineering-style observational field study—not a biological-effects study, health-outcome assessment, laboratory exposure system, or claim that the room behaves as a statistically uniform reverberation chamber.

The protocol deliberately separates three mechanisms that may otherwise be conflated: localized proximity to an emitting device; connectivity-driven increases in device transmit power when the shielded envelope reduces network quality; and room-scale reflection, multipath, or increased spatial persistence of HF energy.

Research Questions and Hypotheses

The primary question is whether partial HF shielding changes measured HF power density inside a room when an HF-emitting device operates there, compared with passive baseline and comparable non-shielded conditions. Secondary questions address passive attenuation, active-source elevation, distance gradients, room-wide persistence, sustained-use averages, and device power control under degraded connectivity.

Study Design and Measurement Controls

The study uses an exploratory, on-site, repeated-measurement controlled-scenario design. The required locations are the partly shielded low-EMF room and immediate reference points outside its door, walls, or windows. A comparable non-shielded room is strongly recommended as a control environment.

Site records include room dimensions, construction and shielding type, shielded surfaces, grounding or equipotential-bonding information, door and glazing details, furniture and reflective objects, nearby wireless infrastructure, source positions, measurement points, and photographs. Required instrumentation comprises a broadband HF meter with data logging, an isotropic probe covering relevant cellular and Wi-Fi bands, and a non-metallic tripod. The same phone, source settings, probe height, room layout, traffic pattern, and limited-movement conditions are retained where possible.

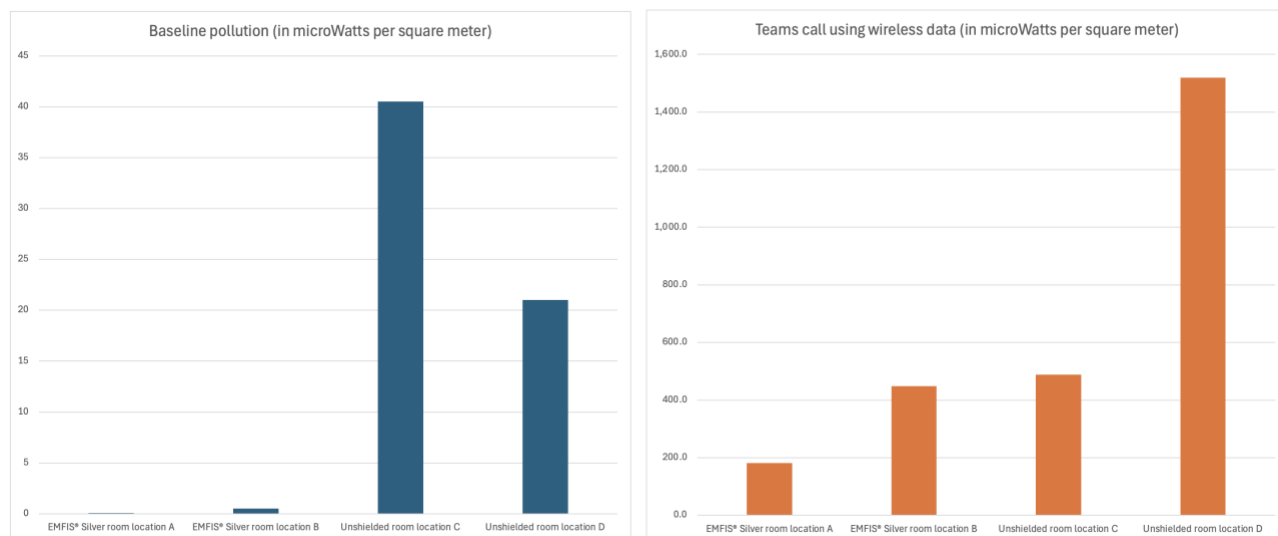
Standardized Test Procedure

- For passive baseline, disable or remove intentional internal sources, record the door state, and measure the indoor grid and external reference points.
- For phone proximity testing, use fixed distances where feasible, with consistent device orientation and a defined activity pattern.
- For room-scale testing, fix the phone at an occupant-relevant location and repeat measurements across the room grid, separating cellular-only, Wi-Fi-only, and mixed modes where possible.
- For the indoor access-point test, fix its position, channel, and output power and compare idle, active traffic, lower-power, and higher-power states.
- Use 60-second logging runs, allow stabilization, avoid movement near the probe, record network drops or other anomalies, and perform return-to-baseline checks after key scenarios.

Each record should include date and time, room type, point identifier, probe height, scenario, source type and distance, door state, Wi-Fi and cellular state, duration, average or RMS value, peak value, instrument setting, and contextual notes. Planned outputs include baseline-to-active comparisons, distance-response curves, shielded-to-unshielded comparisons, spatial heatmaps, and peak-to-average profiles.

Early Field Results

Pre-publication results from this study provide valuable early insights.



The measurements indicate that the EMFIS® Silver Certified room substantially reduced passive background exposure at the tested locations. When a VoIP call was introduced, levels increased, as expected when an active wireless source is used within an occupied space.

Importantly, these early results do not show evidence of a reverberation effect; on the contrary, the EMFIS-certified space is safer in all scenarios. The observed pattern is encouraging for the future of low-EMF construction. It suggests that well-designed shielding can reduce external background fields without necessarily producing problematic room-scale persistence of emissions from internal devices under the tested conditions. These findings remain preliminary and specific to the tested room, equipment, and scenarios. Substantially more research, including repeated measurements under matched and independently reviewable conditions, is needed before broader conclusions can be drawn.

Exposure Reduction, Shielding, and Verification

Research concerned with electromagnetic compatibility and interference is relevant to the design of controlled indoor environments.

The EMFIS® bibliography includes:

- Kellogg, Navigating the Selection of Magnetic Resonance Imaging Shielding Systems.
- Kwok, high-frequency interference in magnetic resonance imaging: Identification and rectification.

These publications concern MRI environments and should not be represented as direct evidence of health effects from ordinary building exposure. They are relevant, however, to the technical understanding of electromagnetic interference, shielding, and the behavior of electromagnetic energy within enclosed spaces.

The EMFIS® Technical Handbook addresses electromagnetic-field attenuation, reflection, and absorption through construction materials, together with whole-space, partial-shielding, and mitigation approaches.

HHS should support independent research into the effectiveness and possible unintended consequences of mitigation measures. Such research should examine:

- Performance across relevant frequencies.
- Installation quality and continuity.
- Long-term material performance.
- Post-installation measurements.
- Interaction with internal wireless sources.

- Electrical safety and grounding considerations.
- Whether an intervention measurably reduces exposure in occupied areas.

Environmental Evidence

HHS should coordinate with relevant environmental agencies when reviewing evidence concerning plants, animals, and ecosystems.

The EMFIS® research library includes Tran et al., Impacts of Radio-Frequency Electromagnetic Field on Lettuce: Evidence for high-frequency EMF Interference with Plant Stress Responses.

Environmental studies should be assessed independently from human-health studies because exposure conditions, biological endpoints, and evidentiary frameworks differ. Nevertheless, environmental findings may identify mechanisms or ecological questions requiring further investigation.

Public-Health and Economic Context

The EMFIS® bibliography includes research on the economic burden of cancers, Alzheimer’s disease and other dementias, heart failure, coronary heart disease, and non-communicable diseases. It also contains broader literature on chronic inflammation, occupant health, and demand for healthy buildings.

These sources establish context for the importance of preventive public-health research, but they should not be cited as proof that EMF exposure causes these conditions. Their appropriate function in the submission is to demonstrate the potential social and economic value of identifying modifiable environmental risk factors through rigorous research.

Federal Research Priorities Recommended by EMFIS®

EMFIS® recommends that federal agencies prioritize the following areas:

1. Longitudinal Exposure Research

Studies combining repeated personal or environmental measurements with clearly defined health endpoints.

2. Real-World Cumulative Exposure

Evaluation of simultaneous exposures from Wi-Fi, mobile networks, smart meters, wearables, IoT systems, building automation, power infrastructure, and other sources.

3. Children and Developmental Exposure

Research addressing prenatal exposure, childhood exposure, schools, childcare environments, and age-related differences in exposure circumstances.

4. Indoor Exposure Science

Investigation of propagation, reflection, attenuation, spatial variability, and reverberation within occupied buildings.

5. Standardized Measurement Protocols

Development of reproducible procedures for residential, educational, occupational, and healthcare environments.

6. Mechanistic Research

Replication and clarification of reported effects involving oxidative stress, mitochondrial function, calcium signalling, inflammation, and neurological pathways.

7. Occupational Exposure

Improved characterization of workers exposed to high-frequency, ELF magnetic fields, or industrial electromagnetic equipment.

8. Exposure Reduction and Mitigation

Independent testing of source-management, distance-based, wired, shielding, and building-design interventions.

9. Post-Intervention Verification

Measurements establishing whether mitigation produces durable reductions under normal operating conditions.

10. Open Research Infrastructure

Shared exposure datasets, harmonized metadata, transparent protocols, and coordinated work among NIH, FDA, CDC, and other relevant federal authorities.

Consumer and Building-Level Disclosure

HHS should consider whether occupants, schools, workers, and local authorities would benefit from accessible information concerning:

- Installed wireless systems.
- Fixed transmitting equipment.
- Relevant operating frequencies.
- Typical and maximum operating conditions.
- Location of principal sources.
- Available exposure measurements.
- Measurement dates, methods, and uncertainty.
- Meaningful changes to installed systems.
- Practical options for managing unnecessary exposure.

Disclosure should be accurate and comprehensible without implying that the mere presence of a wireless source establishes a health effect.

Conclusion

EMFIS® supports a transparent, balanced, and interdisciplinary federal assessment of EMF exposure.

The current literature includes international assessments, observational studies, animal studies, experimental research, mechanistic investigations, occupational studies, and building-science research. The findings are not uniform, and important uncertainties remain. Those uncertainties support better exposure characterization, standardized methods, independent replication, and long-term research.

As wireless technologies, smart-building systems, and connected devices become more deeply integrated into occupied environments, exposure assessment needs to reflect the conditions people actually experience. This includes multiple sources, changing operating conditions, duration, spatial variability, building materials, reflections, and cumulative exposure.

EMFIS® is prepared to contribute its building-assessment perspective, measurement experience, certification methodology, scientific reference library, and forthcoming work on EMFIS® Certified Space Reverberation to future federal research and standard-development efforts.

EMFIS®, Chemin des Primevères 19, 1700 Fribourg, Switzerland.

Website: <https://emfis.org/>

Presentation references: <https://emfis.org/20250720>

Science resources: <https://emfis.org/science>

Research downloads: <https://emfis.org/downloads>

Best regards,

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References

- Awada, M., et al. (2021). Ten questions concerning occupant health in buildings during normal operations and extreme events including the COVID-19 pandemic. *Building and Environment*, 188.
- Clegg, F. M., Sears, M., Friesen, M., Scarato, T., Metzinger, R., Russell, C., Stadtnr, A., & Miller, A. B. (2020). Building science and high-frequency radiation: What makes smart and healthy buildings. *Building and Environment*, 176, 106324.
- Council of Europe, Parliamentary Assembly. (2011). Resolution 1815: The potential dangers of electromagnetic fields and their effect on the environment.
- Environmental Health Trust. (n.d.). About Environmental Health Trust. <https://ehtrust.org/about/>
- ETAIN Project. (n.d.). ETAIN: Exposure to electromagnetic fields and planetary health. European Union Horizon Europe, Grant Agreement No. 101057216. <https://www.etaingroup.eu/>
- European Academy for Environmental Medicine. (2016). EUROPAEM EMF guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses.
- European Commission, Scientific Committee on Emerging and Newly Identified Health Risks. (2015). Potential health effects of exposure to electromagnetic fields (EMF).
- Grellier, J., et al. (2014). Potential health impacts of residential exposures to extremely low frequency magnetic fields in Europe. *Environment International*, 62, 55–63.
- Hardell, L. (2017). World Health Organization, high-frequency radiation and health: A hard nut to crack. *International Journal of Oncology*, 51(2), 405–413.
- Huss, A., et al. (2018). Occupational extremely low frequency magnetic fields exposure and hematolymphopoietic cancers: Swiss National Cohort analysis and updated meta-analysis. *Environmental Research*, 164, 467–474.
- International Agency for Research on Cancer. (2013). Non-ionizing radiation, part 2: high-frequency electromagnetic fields (IARC Monographs, Vol. 102). World Health Organization.
- Jaffar, F. H. F., et al. (2019). Adverse effects of Wi-Fi radiation on male reproductive system: A systematic review. *The Tohoku Journal of Experimental Medicine*, 248(3), 169–179.
- Jiang, D., et al. (2016). Long-term electromagnetic pulse exposure induces A β deposition and cognitive dysfunction through oxidative stress and overexpression of APP and BACE1. *Brain Research*, 1642, 10–19.
- Khayat, S., et al. (2023). Effects of prenatal mobile phone radiation exposure on MMP9 expression. *Toxicology Reports*, 11, 378–384.
- Kim, J. H., et al. (2019). Possible effects of high-frequency electromagnetic field exposure on central nerve system. *Biomolecules & Therapeutics*, 27(3), 265–275.
- Lai, H., & Levitt, B. B. (2023). Cellular and molecular effects of non-ionizing electromagnetic fields. *Reviews on Environmental Health*. <https://doi.org/10.1515/reveh-2023-0023>
- Schuermann, D., & Mevissen, M. (2021). Manmade electromagnetic fields and oxidative stress—Biological effects and consequences for health. *International Journal of Molecular Sciences*, 22(7), 3772. <https://doi.org/10.3390/ijms22073772>
- Fang, S., & Chen, S. (2026). Biological effects of high-frequency electromagnetic fields on CNS function and neuroimmune responses: A systematic review of in vitro and in vivo experimental studies. *Neurotoxicity Research*, 44(4), 32. <https://doi.org/10.1007/s12640-026-00810-5>
- Kaadán, A., Salati, S., Cadossi, R., & Aaron, R. (2025). Regulation of inflammatory responses by pulsed electromagnetic fields. *Bioengineering*, 12(5), 474. <https://doi.org/10.3390/bioengineering12050474>
- Moskowitz, J. M. (n.d.). Joel Moskowitz. University of California, Berkeley School of Public Health. <https://publichealth.berkeley.edu/people/joel-moskowitz>
- Swedish Radiation Safety Authority. (2024). Recent research on electromagnetic fields and health risk: Nineteenth report from SSM's Scientific Council on Electromagnetic Fields.
- Swiss Tropical and Public Health Institute. (n.d.). ETAIN: Exposure to electromagnetic fields and planetary health. <https://www.swisstph.ch/en/projects/project-detail/project/etaingroup-exposure-to-electromagnetic-fields-and-planetary-health>
- Tran, N. T., Jokic, L., Keller, J., Geier, J. U., & Kaldenhoff, R. (2023). Impacts of radio-frequency electromagnetic field on lettuce. *Plants*, 12, 1082.
- World Health Organization, International Agency for Research on Cancer. (2011, May 31). IARC classifies high-frequency electromagnetic fields as possibly carcinogenic to humans [Press release].

- Grigoriev, P. E., & Khorseva, N. I. (2024). Electromagnetic fields of cellular communication as risk factors able to produce negative effects on the central nervous system of children and adolescents: Part 1. Modelling, parameters of electroencephalography and sensorimotor reactions. *Health Risk Analysis*.
- Ito, M., et al. (2025). Extremely low-frequency electromagnetic field enhances mitochondrial energy production in NARP cybrids. *Nature*.
- Ma, T., et al. (2023). Electromagnetic fields regulate calcium-mediated cell fate of stem cells: Osteogenesis, chondrogenesis and apoptosis. *Stem Cell Research & Therapy*, 14.
- Ouadah, N. S., et al. (2018). Possible effects of high-frequency electromagnetic fields on in vivo C6 brain tumors in Wistar rats. *Laboratory Investigation*, 140, 539–546.
- Parizek, D., et al. (2023). Electromagnetic fields: Do they pose a cardiovascular risk? *Physiological Research*, 72(2), 199–208.
- Savchenko, L., et al. (2023). Myocardial capacity of mitochondrial oxidative phosphorylation in response to prolonged electromagnetic stress. *Frontiers in Cardiovascular Medicine*.
- Sharpe, M. A., et al. (2021). Rotating magnetic fields inhibit mitochondrial respiration, promote oxidative stress and produce loss of mitochondrial integrity in cancer cells. *Frontiers in Oncology*.
- Wang, Y., et al. (2023). Electromagnetic field and cardiovascular diseases: A state-of-the-art review of diagnostic, therapeutic, and predictive values. *FASEB Journal*, 37(10).
- Xu, Y., et al. (2016). Health effects of electromagnetic fields on reproductive-age female operators of plastic welding machines in Fuzhou, China. *Journal of Occupational and Environmental Medicine*, 58(12), 148–153.
- Yavaş, M. C., et al. (2024). The effect of short-term electromagnetic fields caused by mobile phones on the electrical activity of alpha and beta brain waves. *Annals of Clinical and Analytical Medicine*, 474.
- EMFIS®. (n.d.). Science. <https://emfis.org/science>
- EMFIS®. (n.d.). Downloads. <https://emfis.org/downloads>
- EMFIS®. (2025, July 20). Presentation references. <https://emfis.org/20250720>
- U.S. Environmental Protection Agency. (n.d.). Electric and magnetic fields from power lines. <https://www.epa.gov/radtown/electric-and-magnetic-fields-power-lines>
- U.S. Environmental Protection Agency. (n.d.). Radiation resources outside of EPA. <https://www.epa.gov/radiation/radiation-resources-outside-epa>
- Occupational Safety and Health Administration. (n.d.). Extremely low frequency radiation: Overview. <https://www.osha.gov/elf-radiation>
- California Public Utilities Commission. (n.d.). Electric magnetic fields. <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/permitting-and-environmental-review/electric-magnetic-fields>
- MedNIS. (n.d.). Swiss Medical Advisory Network on Non-Ionizing Radiation. Institute of Family Medicine, University of Fribourg. <https://www.mednis.ch/fr>