ADDITIONAL 4 · NATIONAL PLAN

National Plan for Electromagnetic Biocompatibility in Modern Vehicles

A proposal for whole-vehicle exposure assessment, occupant dosimetry and regulatory development

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Evidence grades (a) peer-reviewed, standards body, court or regulatory record, or accredited laboratory report; (b) institutional report, agency guidance, preprint, thesis or recognized seal; (c) manufacturer, advocacy or media source
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Relationship disclosure. EFEIA operates within the NOXTAK Corporation ecosystem. The author, J. Joaquín Machado, is EFEIA's Founder and Director and also NOXTAK's founder and CTO. NOXTAK markets SPIRO, a passive nanocomposite that does not attenuate the signal. Source S4, a peer-reviewed article by the author, evaluates it in two vehicles, and Part 9 refers to it among the passive nanocomposite approaches investigated by the proponent. The 180 cases in Part 7 were received by NOXTAK. Sources S2 and S5 to S8 are the author's own articles. Part 9 places every mitigation approach under the same independent protocol, and Part 10 states that success would not be defined by endorsing a particular mitigation product.

REQUESTED ACTION

Establish a coordinated United States research and standards program, with independent laboratory participation, to produce a reproducible whole-cabin protocol, an occupant dosimetry dataset, a structured symptom registry, and recommendations for a vehicle-specific regulatory framework.

Executive Proposal

We propose a national program to evaluate modern vehicles as complete electromagnetic exposure environments and to develop a scientifically defensible framework for occupant protection. The program would integrate realistic driving and connectivity scenarios, measurements across relevant frequency bands, anatomically representative dosimetry, clinical research, and independently reproducible testing. It would apply to battery electric, hybrid, and modern combustion vehicles, including connected and increasingly automated platforms.

The central gap is the incomplete connection between component emissions, the operating cabin, energy absorbed or fields induced in occupants, and health-relevant outcomes. Existing compliance assessments and research provide important protection and evidence. They do not, by themselves, establish the full exposure profile of every seating position, occupant anatomy, software configuration,

and combination of active sources over repeated real journeys. A compliant component is one part of the evidence needed to characterize an occupied vehicle.

The public discussion must extend beyond traction batteries and electric motors. Cellular links, Wi-Fi, Bluetooth, ultra-wideband systems, vehicle communications, and radar can contribute to exposure, alongside power electronics and other electrical equipment. The contribution of each depends on actual transmission, placement, direction, duty cycle, and coupling to the body. Fuel type alone cannot determine the exposure profile.

Meaning of biocompatibility. In this proposal, electromagnetic biocompatibility is a design and assessment objective that links exposure control with evidence on biological interaction and health. It is a proposed framework, not an existing certification or a claim that any vehicle is universally harmless.

1 The Methodological Gap

From emissions to the person in the seat

A vehicle can meet a technical emissions specification while substantial questions remain about how its installed systems expose a particular occupant. Electromagnetic compatibility addresses interference and equipment operation. Human exposure assessment addresses interaction with the body. Health research addresses whether that interaction produces an adverse outcome. These questions require related but distinct methods; one result should not be presented as answering all three.

We propose to make the occupant the organizing unit of evaluation. For each seating position, the assessment should identify which fields reach the body, how they vary during actual use, what internal quantities they produce, and how uncertainty changes the interpretation. This requires measurements and models of occupied conditions, rather than relying exclusively on measurements at isolated components or convenient cabin points.

Existing methods provide a foundation

IEC 62764-1 provides a vehicle measurement methodology for low-frequency magnetic fields from 1 Hz to 100 kHz, across engine types. Its stated scope excludes intentionally transmitting RF antennas. UN Regulation No. 10 addresses vehicle electromagnetic compatibility. These are useful foundations with different purposes; their existence does not establish a single integrated occupant assessment covering the entire installed source inventory. [R1, R2]

United States FCC rules already address human RF exposure, including mobile and portable devices, and provide for multiple RF sources. The gap therefore must not be described as a complete absence of RF protection or simultaneous source assessment. We seek a vehicle-specific, auditable way to demonstrate how those obligations translate into the occupied cabin and how remaining research questions will be addressed. [R3]

The questions an expanded protocol must answer

Does the test reproduce real seating and child restraint positions? Does it capture brief operating events and intermittent transmissions? Does it cover the actual radar and communications bands? Are personal devices and external networks distinguished from vehicle sources? Are measured fields connected to validated internal dose estimates? Can another laboratory reproduce the result after a software update?

The proposed framework would report current compliance, exposure characterization, and health research findings separately. Uncertainty would trigger appropriate investigation, not an automatic declaration of injury. Compliance would remain meaningful within the conditions and endpoints it addresses, without being expanded into a blanket promise of health under every use condition.

2 Evidence Supporting the Proposed Expansion

A relevant independent precedent

The final report of 31 March 2023 funded by the Swiss Federal Office of Energy examined five battery electric vehicles and one diesel comparison vehicle. It included real operating conditions, charging, low-frequency magnetic fields, and RF measurements. Its reported average utilization of reference limits was generally low, with occasional localized magnetic field peaks. The report nevertheless identified unresolved questions about vehicle interior regulation and increasing connectivity. [S1, pp. 4-5]

Its conclusions specifically acknowledge temporal and spatial gaps that could have missed short events or the highest field values, and call for higher-resolution targeted measurements for a strict worst-case assessment. This directly supports extending measurement capability. It also prevents the inaccurate claim that existing studies have never examined real driving or RF exposure. [S1, pp. 59-60]

The EFEIA vehicle investigation

The 2025 Tesla Model Y article reports 952 electromagnetic data points across two vehicles, 2021 and 2022 models, with observations during driving, idle, and charging conditions. It describes spatial variability, RF activity, electric and magnetic field measurements, body voltage observations, and an exploratory before-and-after intervention. It provides a practical starting point for a broader independent campaign, rather than a fleet-wide conclusion. [S4]

The paper describes sub-6 GHz RF instrumentation; it cannot establish measured exposure from 24 GHz, 60 GHz, or 76 to 81 GHz systems without additional instrumentation. Body voltage observations are not tissue absorption measurements. Its environmental bioelectrography outcomes are not SAR measurements or clinical endpoints. The paper itself calls for larger samples, longitudinal evaluation, and physiological research. [S4, pp. 135-138]

RF exposure and dosimetry already have precedents

A 2021 numerical study modeled 5.9 GHz vehicle communications with an adult occupant and reported SAR below the applicable limits in its scenarios. It demonstrates the feasibility of vehicle-specific dosimetry. A separate 2022 measurement study found that an internally mounted ITS-G5 transmitter produced the largest electric fields among the Wi-Fi, Bluetooth, and ITS-G5 configurations it tested, with a maximum of 15.1 percent of the corresponding ICNIRP reference level. Neither finding establishes the exposure of every production vehicle. [R4, R5]

The German BfS 2025 driving report is a further national precedent for systematic vehicle exposure research. The proposed program would use existing work as a baseline and extend it across RF configurations, occupant diversity, and repeated use. [R6]

3 The Modern Cabin and the Occupants It Must Represent

Modernization is an exposure variable

Modern vehicles integrate communication, sensing, processing, displays, recording, and automation into a compact occupied space. Their electromagnetic profiles should be classified by installed architecture and actual operation as well as propulsion type. A connected combustion vehicle may require the same RF assessment as a similarly equipped electric vehicle; a simple electric vehicle should not be assigned a higher RF dose merely because it has a traction battery.

The source inventory must distinguish intentional RF transmitters, electrical circuits and unintentional emissions, and passive receivers. Cameras do not become RF transmitters because they record images.

Satellite navigation receivers primarily receive signals. LiDAR and infrared illumination are optical technologies requiring the relevant optical safety assessment. Their electronics may also produce unintentional emissions, but their optical output must not be counted as microwave power.

Potential RF sources include cellular modems, onboard hotspots, Bluetooth links, ultra-wideband access systems, tire pressure transmitters, V2X equipment, and radar, where fitted and active. Interior radar must be distinguished from outward-looking road radar; antenna direction, location, shielding, and operating state determine occupant exposure. The FCC has enabled radar applications in the 57 to 71 GHz band, including child presence detection, illustrating why a sub-6 GHz survey cannot cover all relevant systems. [R7]

An inclusive occupant model

The program should represent infants and children in rear- and forward-facing restraints, adolescents, adults across body sizes, pregnant occupants across gestational stages, older adults, and professional drivers. It should also include a clinically supervised research pathway for people reporting neurological or autonomic symptoms, and a separate device interference assessment for implanted or worn medical equipment.

These groups raise different questions. Anatomy affects position and dose distribution; pregnancy requires maternal and fetal modeling; professional use changes journey duration and repetition; implanted equipment introduces interference concerns. Older age or a neurological diagnosis does not by itself prove greater RF absorption or establish an adverse response. The protocol must test the relevant hypothesis for each group.

> **Required output.** A vehicle and occupant classification system based on measured sources, realistic geometry, and documented use. Architecture or sensor counts may guide sampling, but must not serve as a substitute for exposure or health measurements.

4 A National Library of Real-Use Scenarios

The protocol should combine reproducible laboratory scenarios with instrumented road journeys. Standardization makes results comparable; field work establishes whether those scenarios represent actual use. Tests must document the production configuration and preserve safety functions.

Driving and electrical operation

Measure startup and shutdown, stationary operation, urban stop-and-go traffic, steady highway travel, acceleration, regenerative and friction braking, hill climbing, and changes in power demand. Repeat appropriate combinations across battery state of charge and thermal conditions. Record seat heaters, ventilation, defogging, lighting, audio, displays, and other auxiliaries so that traction and non-traction sources can be separated.

Charging and stationary occupancy

Evaluate occupied AC and DC charging where permitted, connection and disconnection events, and the locations of cables and power conversion equipment relative to occupants. Include phone charging, wireless charging pads, and bidirectional power export where supported. Wireless vehicle charging requires a dedicated configuration and must not be inferred from wired charging measurements.

Connectivity and sensing

Test idle connections, calls, uploads, streaming, navigation, hotspot traffic, and several personal devices using defined workloads. Compare strong and weak network coverage and handovers with logged

transmit behavior. Exercise interior radar and available V2X or other RF functions under safe, manufacturer-documented conditions. Record beam direction and duty cycle rather than assuming every radio emits continuously at maximum power.

Occupancy and the surrounding environment

Test an adult driver alone, front and rear passengers, child restraints in approved positions, and multiple occupants. Include posture changes and realistic device locations such as a handset on a console, in a pocket, or near a seated passenger. Use phantoms before exposing people in deliberately demanding conditions. Compare urban, suburban, rural, tunnel, parking structure, and traffic congestion settings, with exterior reference monitoring.

Ordinary use and credible upper bounds

Maintain separate typical-use distributions and credible worst-case tests. Define scenarios before testing and identify combinations that are physically possible, including operating interlocks. An artificial state with every subsystem forced to maximum may provide a conservative bound, but must be labeled accordingly. Repeat selected routes, days, vehicles, and drivers to quantify variability and avoid treating a single trip as representative of a model.

> **Required output.** A version-controlled scenario library with source states, occupant geometry, route metadata, repetition requirements, and explicit limits on generalization.

5 Measurement Requirements Across the Relevant Spectrum

A coordinated instrument system

Use calibrated, complementary instruments for static and time-varying electric and magnetic fields, switching components and harmonics, RF communications, and microwave radar. A single broadband meter cannot establish the complete exposure profile. The source inventory should determine band coverage, including intermediate frequencies and extensions above 6 GHz through the highest installed RF band, such as 60 GHz and 76 to 81 GHz where applicable.

Record electric and magnetic components separately where required, with characterized triaxial response, isotropy, dynamic range, probe dimensions, loading, and calibration uncertainty. Proximity alone does not classify a source as near field: wavelength, antenna geometry, and distance must be evaluated. Where plane-wave assumptions fail, do not convert an electric field reading to power density using a free-space relationship without demonstrating validity.

Resolve brief events without losing compliant averages

Capture RMS levels and the averaging quantities required by applicable standards, together with documented peaks, pulse duration, duty cycle, repetition rate, and relevant time-frequency structure. The acquisition bandwidth and sampling must resolve the event under study; slow logging cannot reconstruct a missed transient. Record analyzer settings, detector type, sweep behavior, and blind time so a displayed maximum can be interpreted correctly.

For modulated or burst signals, retain suitable time-domain or IQ recordings where feasible, subject to privacy controls. Distinguish physical transients from probe motion, overload, aliasing, cross-sensitivity, and vehicle vibration. A brief peak is neither harmless nor harmful solely because it is brief; significance depends on validated magnitude, duration, frequency, coupling, and the relevant endpoint.

Spatial mapping and source attribution

Map head, torso, abdomen, pelvis, limbs, and child seat locations with sufficient spatial resolution near suspected sources. Synchronize field instruments with vehicle telemetry, radio activity, route position, and a common clock. Combine controlled source state changes with simultaneous exterior monitoring. Document interference introduced by the measurement equipment itself.

Measure occupied and unoccupied configurations and quantify the influence of probes, phantoms, and passengers. Use source attribution to distinguish built-in equipment, personal devices, chargers, nearby vehicles, and infrastructure. Cabin reflections can redistribute fields and create localized maxima or minima; a metallic enclosure does not automatically increase exposure everywhere or by a fixed factor.

> **Required output.** Seat-resolved exposure maps and time series, with calibration records, uncertainty budgets, detection limits, coverage gaps, and independently usable metadata.

6 Occupant Absorption and Internal Dosimetry

Connect external fields to internal quantities

The principal advance is to connect measured cabin conditions to quantities inside anatomically representative occupants. At low frequencies, assess induced internal electric fields and other quantities appropriate to the governing criteria. At RF, estimate whole-body and local SAR where applicable. At higher microwave frequencies, assess absorbed power density or other frequency-appropriate quantities, with spatial and temporal averaging explicitly stated.

At millimeter-wave frequencies, absorption is concentrated toward superficial tissues. Evaluation should therefore resolve skin and exposed ocular regions where relevant; deep-tissue dose must not be inferred solely from the presence of a high-frequency source. Different frequency ranges require different biological and dosimetric interpretations. [R8]

Validate occupied vehicle models

Build numerical models of the vehicle geometry, materials, glazing, antennas, seats, and occupants. Compare predicted external fields with measurements and validate selected absorption estimates through appropriate physical phantoms and established dosimetry procedures. Demonstrate mesh convergence, solver verification, sensitivity to material properties, and agreement between laboratories before using models for regulatory conclusions.

Include multiple anatomical models, seating positions, child restraints, and gestational stages, with uncertainty in tissue properties and posture. Report tissue and body region distributions, not only a cabin mean or a single adult driver. Compare models under matched sources; neither children nor adults should be assumed universally to receive the highest local dose.

Combined sources and repeated journeys

Apply the relevant standard-specific rules for simultaneous exposures and preserve frequency-resolved contributions. Sources at different frequencies, phases, and duty cycles cannot be combined by simply adding electric field magnitudes or unlike units. Where correlated transmissions matter, model the relevant phase relationships; where they do not, document the appropriate power-based combination and assumptions.

Describe trip duration, time above predefined exposure levels, and repeated daily patterns. Integrated absorbed energy can support exposure reconstruction, but it is not automatically a validated predictor of chronic disease. Compare field profiles and absorbed quantities against matched everyday environments using consistent instruments, frequency coverage, anatomy, and duration.

> **Required output.** A validated occupant dosimetry atlas linking realistic scenarios to internal field or absorbed energy quantities, with uncertainty bounds and transparent comparisons. Body voltage may be explored as a supplementary coupling indicator, but it cannot replace this dosimetry.

7 Health Research and the 180 Reported Cases

The clinical motivation reported by the proponent

As CTO of NOXTAK and an electromagnetic radiation researcher, J. Joaquín Machado reports that, as of 21 October 2026, NOXTAK has received 180 cases involving people who attribute symptoms or adverse experiences to electric vehicle use. These individuals approached the organization seeking assistance, including approaches intended to filter electromagnetic contamination. This accumulated experience motivates a structured investigation and a pathway for appropriate clinical evaluation.

The 180 figure is an author-reported service case count. It is not a population prevalence estimate, an independently adjudicated set of EMF-induced injuries, or proof of a specific causal mechanism. The proposed registry would verify unique individuals and available records, distinguish reported symptoms from diagnosed conditions, and document any intervention and outcome without assuming improvement.

A prospective clinical research pathway

With consent and independent ethics review, record symptom timing, severity, functional impact, vehicle configuration, seating, trip conditions, medication, baseline diagnoses, and contemporaneous exposure. Use validated symptom instruments where available. Link exposure and outcome records through protected identifiers, and separate clinical assessment from product selection or sales.

Include differential assessment of motion sickness, acceleration and braking characteristics, vibration, noise, visual display use, heat, ventilation, fatigue, stress, and other medical causes. Expectation and nocebo effects should be measured without dismissing symptoms or assigning psychological causation by default. The same discipline must prevent automatically attributing every symptom to EMF.

Research below established thermal thresholds

The program should investigate whether realistic cabin exposures produce reproducible physiological changes below levels associated with established thermal injury, and whether any such changes are adverse, persistent, or clinically meaningful. Exposure measurement alone cannot establish a non-thermal biological mechanism or high biological harm. ICNIRP states that its assessment considers adverse effects regardless of mechanism; disagreement with its conclusions requires evidence, not an assertion that non-thermal literature was categorically excluded. [R8]

Use preregistered, adequately powered studies with sham conditions, randomized order, participant and assessor blinding where feasible, validated dosimetry, temperature control, and correction for multiple comparisons. Initial endpoints may include symptoms, autonomic function, sleep or attention, and justified laboratory biomarkers. HRV, EEG, oxidative stress markers, or exploratory imaging would each require controls and interpretation; none alone certifies electromagnetic protection.

> **Required output.** An ethically governed registry and a staged clinical research protocol, with independent replication before causal or protective claims enter certification.

8 A Proposed Regulatory Framework for Whole Vehicles

Make the evidence reviewable

We propose development of a United States vehicle-specific electromagnetic exposure framework that supplements existing obligations. The framework would require manufacturers to explain how the installed combination of systems has been assessed for actual occupants under specified use conditions. Its legal form, responsible authorities, and enforcement pathway should be established through an interagency review and public consultation.

DOT and NHTSA should be invited to examine vehicle integration and transportation safety; FCC participation would address RF equipment and exposure requirements; HHS and relevant research agencies would guide health evidence. NIST, universities, independent laboratories, and standards organizations could support measurement traceability and method development. These are proposed roles, not claims of an existing mandate or endorsement.

Minimum elements of a cabin exposure dossier

Require a production-specific inventory of transmitters, antennas, frequency ranges, operating modes, power control, source placement, and software version. Include the validated scenario matrix, seat-resolved measurements, occupant dosimetry, uncertainty, simultaneous source evaluation, and the conditions supporting compliance. Protect legitimate confidential information while publishing enough technical detail for independent review.

Require representative testing of child and pregnant occupant geometries where relevant, long-duration professional use patterns, and medical device interference as a separate assessment. A research concern about a population should lead to a defined evaluation, not an invented susceptibility multiplier or unsupported numerical limit.

Clear findings and conditional accreditation

Reports should state separately whether tested conditions comply with applicable limits, how comprehensively the cabin has been characterized, and which health questions have been investigated. An independent accreditation must identify the tested vehicle configuration, methods, frequency range, occupants, scenarios, uncertainty, and expiration or reassessment triggers. Avoid unrestricted labels such as "radiation-free" or "healthy for everyone".

Require change control when antenna placement, transmitter power, radio scheduling, interior sensing, hardware, or software could materially alter exposure. Support independent market sampling and a complaint reporting channel. Findings requiring enforcement under existing rules should be referred promptly to the competent authority, rather than deferred until the research program concludes.

> **Regulatory objective.** A transparent whole-vehicle evidence requirement that can evolve into enforceable performance provisions as validated methods and health evidence justify them. The proposal does not prescribe a new universal health threshold before that work is completed.

9 Engineering and Mitigation Evaluation

Design exposure management into the vehicle

The program should encourage manufacturers to manage exposure through antenna placement, separation from occupied tissues, cable routing, balanced current paths, filtering at the source, appropriate shielding, and efficient radio power and transmission scheduling. Evaluate realistic low-

activity settings for optional connectivity where feasible. Essential safety systems must remain functional and accessible.

Assess the effects of each intervention on exposure throughout the cabin and around the vehicle, rather than at a single favorable point. Confirm that attenuation or shielding does not trigger higher transmit power, move a hotspot toward another passenger, impair emergency communication, or degrade radar and other safety functions. Evaluate thermal management, electrical safety, electromagnetic compatibility, and reliability alongside exposure.

A technology-neutral pathway for filtration claims

Approaches intended to filter or modify electromagnetic contamination, including passive nanocomposite approaches investigated by the proponent, should be eligible for evaluation under the same independent protocol as other interventions. Their proposed mechanism and measurable endpoints must be stated clearly. A method that claims benefits without reducing field amplitude requires evidence appropriate to that claimed interaction; unchanged amplitude neither proves benefit nor rules it out.

EFEIA uses the term artificial quantum noise within its research framework. That concept and related environmental indices should remain explicitly identified as proposed constructs pending independent operational definition and validation. They are not interchangeable with spectrum analyzer noise level, signal-to-noise ratio, internal dose, or established health endpoints.

Before-and-after studies should use randomized or counterbalanced ordering, blinded analysis, sham controls where feasible, and matched operating conditions. Report both favorable and unfavorable results and the uncertainty of the difference. Environmental bioelectrography may be studied as an exploratory supplementary method, but its validity for the claimed quantity must be demonstrated before it can support a regulatory protection decision.

Independent verification of benefit and tradeoffs

A mitigation claim should specify what changed, by how much, where, for which occupants, and under which conditions. Reduced external fields, lower modeled absorption, changed communications performance, and improved symptoms are distinct outcomes. A percentage change in one cannot be substituted for the others. Demonstrating a health benefit requires a suitable clinical study in addition to technical characterization.

> **Required output.** A reproducible mitigation assessment method and an engineering guidance document describing demonstrated benefits, remaining limitations, and possible adverse effects on exposure, communications, and vehicle safety.

10 Implementation and the First National Report

We propose a 24-month initial program consisting of six months of preparation, twelve months of measurement and evaluation, and six months of integrated analysis. This schedule would deliver the first national report and a draft protocol; it would not resolve all long-term health questions. Longitudinal research and standards maintenance would continue afterward.

Table 1. Initial program, by phase.

Months	Work	Outputs
1 to 6	Governance, declared interests and data protection; review of standards and evidence; minimum dataset, scenario library, instrument specifications and dosimetry validation plan; pilot tests, ethics approvals and an initial interlaboratory comparison; stratified fleet sampling plan	Published protocol and analysis plan, before the main campaign
7 to 18	Coordinated laboratory and road testing, occupied model validation, frequency-resolved dosimetry and independent replication of a subset; consented symptom registry and clinical pilot work; engineering interventions under a technology-neutral protocol	Measurement campaign records, with calibration drift, protocol deviations, missing bands and software changes logged
19 to 24	Integration of exposure distributions, localized events, anatomical dose estimates, uncertainty and repeatability; comparison with matched baseline environments; clinical pilot outcomes reported separately	First national report, open technical protocol, occupant dosimetry atlas, deidentified data release, manufacturer guidance, regulatory recommendations

Months 1 to 6: preparation and independent validation

Establish governance, declared interests, data protection, and public research questions. Review existing standards and evidence; define the minimum dataset, scenario library, instrument specifications, and dosimetry validation plan. Complete pilot tests, ethics approvals, and an initial interlaboratory comparison. Publish the protocol and analysis plan before the main campaign.

Develop a stratified fleet sampling plan across propulsion types, vehicle ages, connectivity and sensing architectures, and usage patterns. Include simpler comparison vehicles and more than one unit of selected models. Set sample sizes from pilot variability and precision or statistical power objectives, with a transparent budget and procurement plan. Do not select vehicles solely from an unvalidated exposure ranking.

Months 7 to 18: measurements and evaluation

Conduct coordinated laboratory and road testing, occupied model validation, frequency-resolved dosimetry, and independent replication of a subset. Establish the consented symptom registry and launch feasible clinical pilot work. Evaluate engineering interventions under a technology-neutral protocol. Log calibration drift, protocol deviations, missing bands, and software changes throughout the campaign.

Months 19 to 24: analysis and public reporting

Integrate exposure distributions, localized events, anatomical dose estimates, uncertainty, and repeatability. Compare modern cabins with matched baseline environments and evaluate which configurations explain exposure differences. Report clinical pilot outcomes separately from the larger measurement campaign, with their statistical and causal limits.

Issue the first national report, an open technical protocol, a representative occupant dosimetry atlas, a deidentified data release, manufacturer guidance, and recommendations for regulatory development. Seek external peer review and public comment, then establish revision intervals and longer-term clinical priorities.

Criteria for program success

Success would mean reproducible measurements across laboratories; documented coverage of high-priority sources and scenarios; validated internal dose estimates; transparent handling of uncertainty and the 180 reported cases; and a clear path from findings to standards. It would not be defined by proving a predetermined health effect or endorsing a particular mitigation product.

> **Institutional contribution.** EFEIA and NOXTAK offer their research questions and reported field experience as a basis for collaboration. Any use of case records, raw data, technology, or staff would require documented arrangements, participant consent where relevant, and independent oversight appropriate to the work.

11 The Proposed National Commitment

The modern vehicle should be evaluated as an occupied electromagnetic environment whose behavior changes with connectivity, sensing, power demand, traffic, software, and the people inside it. A whole-vehicle framework would make those conditions visible and connect them to the physical quantities that matter in the body.

As an electromagnetic radiation researcher, my field observations lead me to regard some modern cabins as high-density exposure environments that can substantially exceed other everyday settings in particular bands, locations, or operating moments. That concern warrants direct national investigation. Its magnitude must be established through matched measurements; it is not a demonstrated universal ranking of vehicles above every other source, nor proof of disease. [S2, S4-S8; proponent assessment]

The 180 cases reported to NOXTAK add a human reason to organize this work: people seeking help deserve a documented clinical pathway and a reliable assessment of the environments they identify. Their experiences should generate testable questions and careful follow-up, rather than unsupported assurances, automatic causal attribution, or product claims that cannot be independently evaluated.

We therefore request a coordinated national initiative that brings together transportation engineering, communications, metrology, dosimetry, medicine, physiology, and public health. Its initial task is to establish how modern vehicles expose their occupants under realistic conditions. Its continuing responsibility is to determine when that exposure warrants design changes, further clinical research, or stronger regulatory requirements.

The decisions requested

Authorize the initial program. Support the 24-month preparation, evaluation, and reporting cycle with an independent scientific steering process and participation by relevant public institutions.

Develop the next generation of protocols. Connect source-resolved field measurements, occupied cabin scenarios, and anatomical dose modeling, including RF and microwave systems outside the range of conventional sub-6 GHz surveys.

Create a regulatory pathway. Use validated findings to define whole-vehicle disclosure, test coverage, reassessment after material changes, and evidence requirements for protection claims.

Build long-term capability. Maintain a research and surveillance system for changing vehicle architectures, repeated occupational use, vulnerable occupant questions, and appropriately controlled investigation of non-thermal biological effects.

Our proposed outcome is a new generation of vehicle assessment in which technical innovation, occupant protection, and scientific accountability advance together. The operating vehicle, the person in

the seat, and the evidence connecting them would become the basis of a transparent and reproducible standard.

References and Supporting Documentation

Source identifiers distinguish independent standards and research (R) from the proponent-supplied documents (S). References support the described evidence and current framework; the program design and regulatory requests are proposals by the author. Each source closes with its evidence grade.

Standards and independent research

R1 IEC 62764-1:2022. Measurement procedures of magnetic field levels generated by electronic and electrical equipment in the automotive environment with respect to human exposure. Part 1: Low-frequency magnetic fields. Geneva: International Electrotechnical Commission; 2022. Scope: 1 Hz to 100 kHz, excluding intentionally transmitting radio frequency antennas. https://webstore.iec.ch/en/publication/68086. (a, standard)

R2 UNECE. UN Regulation No. 10. Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility. Official regulation repository and amendments. https://unece.org/transport/vehicle-regulations-wp29/standards/addenda-1958-agreement-regulations-0-20. (a, regulation)

R3 Federal Communications Commission. 47 CFR 1.1307 and 1.1310; 47 CFR 2.1091 and 2.1093. RF exposure requirements and evaluation of mobile and portable devices. Electronic Code of Federal Regulations, reviewed 21 October 2026. https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-1/subpart-I/section-1.1307. (a, regulation)

R4 Tognola G, Masini BM, Gallucci S, et al. Numerical assessment of RF human exposure in smart mobility communications. IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology. 2021;5(2):100-107. doi:10.1109/JERM.2020.3009856. Author accepted manuscript: https://iris.cnr.it/retrieve/30ad01aa-40d2-434d-b23b-bed36324de5b/JERM_AAM.pdf. (a)

R5 Schilling LM, Bornkessel C, Hein MA. Human RF electromagnetic exposure to V2X-communication. Advances in Radio Science. 2022;19:233-239. doi:10.5194/ars-19-233-2022. (a)

R6 Schmid G, Hirtl R, Schneeweiß P, et al. Bestimmung von Expositionen gegenüber elektromagnetischen Feldern der Elektromobilität. Vorhaben 3620S82473. Ergebnisbericht, Teil 1: Elektromagnetische Felder beim Fahren (results report, part 1: electromagnetic fields while driving). Ressortforschungsberichte zum Strahlenschutz, BfS-RESFOR-243/25. Bundesamt für Strahlenschutz; 2025. 461 pp. https://doris.bfs.de/jspui/handle/urn:nbn:de:0221-2025031250843. (b, government research report)

R7 Federal Communications Commission. Allowing expanded flexibility and opportunities for radar operation in the 57-64 GHz band. Report and Order, FCC 23-35, ET Docket No. 21-264. 38 FCC Rcd 5242. Adopted 18 May 2023; released 19 May 2023. Rules for field disturbance sensors in the 57-71 GHz band (47 CFR 15.255), including in-vehicle detection of unattended children. https://docs.fcc.gov/public/attachments/FCC-23-35A1_Rcd.pdf. (a, regulatory record)

R8 ICNIRP. Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz). Health Physics. 2020;118(5):483-524. doi:10.1097/HP.0000000000001210. See also ICNIRP's RF guideline FAQs, on effects considered regardless of the mechanism of interaction: https://www.icnirp.org/en/rf-faq/index.html. (a; FAQs (b))

Proponent-supplied source register

The following documents informed the proposal. Their roles are kept distinct so measurements, background analysis, architectural inference, and reported experience remain traceable.

S1 Eberhard J, Fröhlich J, Zahner M. Elektromagnetische Felder (EMF) in Elektrofahrzeugen. Schlussbericht, project EMFEMOB. Bern: Swiss Federal Office of Energy (SFOE); 31 March 2023. Prepared by Forschungsstiftung Strom und Mobilkommunikation (FSM) and Fields at Work GmbH. https://www.aramis.admin.ch/Dokument.aspx?DocumentID=70257. Independent field study and methodological precedent; especially pp. 4-5, 29-30, 45 and 59-60. (b, institutional report)

S2 Machado JJ. Electromagnetic exposure in hybrid and electric vehicles (EV): how safe are you? 8 January 2021. Includes "The birth of a new standard for electric vehicles." Historical statement of the author's concerns and proposed assessment approach; not used as an up-to-date inventory of current law or proof of universal harm. (c, the author's own article)

S3 Olabi AG, et al. Battery electric vehicles: progress, power electronic converters, strength (S), weakness (W), opportunity (O), and threats (T). International Journal of Thermofluids. 2022;16:100212. doi:10.1016/j.ijft.2022.100212. Engineering background on power conversion and charging, including wireless charging considerations; not a study of clinical outcomes or whole-cabin RF dose. (a)

S4 Machado JJ. Evaluation of EMF exposure in TESLA Model Y (2021/2022) and testing the efficiency of SPIRO technology: an environmental bioelectrography study. Journal of Applied Biotechnology and Bioengineering. 2025;12(4):131-143. doi:10.15406/jabb.2025.12.00395. Two-vehicle exploratory investigation; repeated data points are not independent vehicle samples or clinical cases. (a; evaluates a NOXTAK technology)

S5 Machado JJ. Which EVs expose you to the most EMF? July 2026. Author's explanatory framing and proposal for prioritizing vehicles; not direct comparative fleet dosimetry. (c, the author's own article)

S6 Machado JJ. EVs: the real EMF emission scenario. A fleet of robots: twenty-two electric cabins on a single ruler. July 2026. Architectural index and inferred ranking. Its index, model-specific assumptions, and derived product configurations require independent verification before use in exposure certification; the ranking is not reproduced as measured dose or risk. (c, the author's own article)

S7 Machado JJ. What nobody tells you about EVs and EMF. April 2026. Public framing of the shift from propulsion alone to the broader connected cabin. (c, the author's own article)

S8 Machado JJ. The car that became a robot. April 2026. Author's extended rationale and field interpretations. Proposed mechanisms and broad regulatory statements are distinguished from independently established measurements and rules in this proposal. (c, the author's own article)

The 180-case figure and the accompanying description of assistance requests are provided directly by J. Joaquín Machado for this proposal as of 21 October 2026. Future registry analysis would require consented records, a case definition, deduplication, and independent clinical assessment.