Proposal Title:

CIRCE-Mobile: Circular Intelligence and Resource Cycles for Emissions-Optimized Mobile Ecosystems

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Executive Summary

CIRCE-Mobile is a forward-looking R&D&I proposal led by Ecosystem Informatics Inc. (ESI), aimed at unlocking circular value across vehicle and infrastructure lifecycles using real-time emissions data, ambient air monitoring, and digitalization technologies. Designed in alignment with the Eureka Circular Value Creation (CVC) call, the proposal brings together technology providers, materials scientists, academic researchers, and fleet operators to co-develop an emissions- and environment-informed circularity framework.

Unlike conventional circular economy projects focused solely on materials, CIRCE-Mobile introduces multi-use environmental data streams—captured through mobile, stationary, and aerial platforms—as reusable assets that can guide smart maintenance, lifecycle optimization, and systemic decision-making. The proposal supports the 9R framework (Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle) in both fleet operations and environmental planning contexts.

Objectives

- Design and deploy an integrated system that supports emissions-informed circular decision-making across fleet and environmental systems.
- Incorporate ambient air data collection as a valuable, circular data layer for community, policy, and infrastructure use.
- Build a modular digitalization platform to simulate degradation, emissions behavior, and circular intervention scenarios.
- Extend component lifespans via real-time diagnostics and predictive maintenance strategies.
- Inform future-ready public procurement and policy frameworks that integrate circularity and emissions intelligence.
- Enable SMEs and operators to participate in data-driven circular business models, supported by open and modular architecture.

Relevance to Eureka Circular Value Creation (CVC) Call

1. Systemic Circularity and Value Chains

- New cross-sector synergies: CIRCE-Mobile proposes a novel value chain linking emissions monitoring, ambient air sensing, materials diagnostics, and circular simulation across fleets and infrastructure.
- Full-lifecycle visibility: Real-time data from moving and stationary sources, combined with Life Cycle Assessment (LCA) and degradation testing, would support transparency across use, maintenance, and end-of-life.
- Circular decision support: AI models and digital twins would enable smart reuse, repair, and replacement decisions based on real conditions.
- Scalability across borders/sectors: The modular framework is designed for both municipal and industrial use, adaptable to multiple countries and fleets.
- Sustainable data design: Multi-use data (fleet + ambient) ensures circular value while reducing monitoring redundancies and digital resource waste.

2. Business Models and Smart Services

- Service-based contracting pilots: The consortium would explore emissions-informed performance and service-based contracts that reward longevity and emissions reductions.
- Data-driven business services: ESI's emissions dashboards and the predictive modeling using the digitalization enable monitoring, diagnostics, and planning as-a-service offerings.

- Ambient data monetization: Collected air quality data could support additional use cases—e.g., community exposure reporting, urban planning, ESG dashboards.
- Secondary component markets: Testing and digital certification of parts could enable safe resale, refurbishment, and modular repairs.
- SME enablement: Open interfaces and diagnostics-as-a-service models would foster new business opportunities for local SMEs.
- Governance innovation: The project would explore fair, secure, and interoperable governance models for shared circular datasets.

3. People and Organizational Culture

- Upskilling through training modules: Fleet staff and technicians would be trained on emissions diagnostics, circular repair strategies, and data tools.
- Hands-on cross-training: Operational pilots would include collaborative fieldwork between data scientists, mechanics, planners, and sustainability staff.
- Behavioral shift: Embedding reuse and environmental data thinking into daily operations encourages lasting circular culture.
- AI-supported workflows: The digital twin and dashboard tools would function as accessible assistants in daily maintenance and planning decisions.

Proposed Technical Roles and Responsibilities

A. Ecosystem Informatics Inc. (Lead Technology Proponent)

- Proposes to develop and deploy environment intelligence using modular technologies for both fleet emissions (while vehicle is in-service in real-world settings) and ambient air quality in concurrently.
- Feeds high-resolution emissions data to partners for use in degradation modeling, LCA, and digital twin calibration
- Plans to deliver real-time data feeds, analytics dashboards, and open APIs for use across the consortium.
- Will facilitate secondary use of ambient air data in community planning, regulatory reporting, and smart infrastructure design.

B. Digitalization Partner

- Responsible for co-developing the digital twin framework, combining emissions data and material diagnostics.
- Integrates ESI data and physical material data to create a predictive model for smart maintenance and lifecycle planning.
- Would simulate multiple usage, repair, and replacement scenarios for policy and operational guidance.
- Aims to define quality/safety standards for validated second-life components.

C. Research & Policy Partner (SME/Academia)

- Would conduct lifecycle assessments (LCA) of both vehicle and ambient monitoring streams.
- Plans to model circular outcomes in terms of emissions, cost savings, material recovery, and labor efficiency.
- Would develop policy recommendations and help align the results with procurement and sustainability frameworks.
- Will design and pilot training programs for public and private sector participants.

D. Fleet or Infrastructure Implementation Partner

- Would offer access to real-world testing environments (e.g., municipal bus fleets, logistics depots, mining vehicles).
- Extends support on enabling diagnostics workflows, and trialing component reuse or repair strategies.
- May test new contract structures such as uptime- or emissions-linked SLAs.
- Would collaborate on using ambient monitoring data to inform local planning and reporting.

Innovation Domains

- AI-powered mobile in-service emissions and air quality monitoring simultaneously
- Multi-use environmental datasets as circular value
- Predictive digital twin lifecycle modeling
- Circular procurement and real-time component diagnostics
- Modular, service-based business models for fleet and infrastructure
- Data governance and SME integration frameworks
- Cross-sector workforce training and behavior change

Expected Results

- A validated multi-layer digital twin integrating emissions, environment, and degradation modeling
- Circular diagnostics protocols for public and industrial fleets
- Operational pilot data demonstrating emissions reduction, component life extension, and avoided waste
- Open frameworks for integrating mobile ambient air monitoring into planning, compliance, and service design
- Policy, contracting, and training materials for replication
- Enhanced readiness of SMEs and fleet operators to adopt circular and data-driven models

Conclusion

CIRCE-Mobile represents a next-generation circular economy proposal that merges fleet and environmental intelligence into a unified platform. By treating emissions and air quality data as reusable circular assets, the consortium seeks to deliver technical, economic, and environmental breakthroughs aligned with the priorities of the Eureka Circular Value Creation program. The proposal builds a foundation for cross-border, cross-sector, and multi-purpose circular innovation, with long-term value for public agencies, industries, and communities alike.