

# I. METADATA HEADER

**Code:** EFU-RES-EN-2026-02

**Title:** EFU White Paper – Quantitative Ontology of Life in Technological Civilization (Research Model v1.0)

**Status:** Research material – Open for critical review (Research Phase)

**Version:** 1.0 (English, audited 2026)

**Connectivity:** EFU-100.x (Ontological Foundation), EFU-104.x (Metabolic Flux Measurements), EFU-200.x (Research Audit)

## **Abstract:**

[HYPOTHESIS] The White Paper presents a theoretical research model of the EFU (Ecological Flux Unit) framework investigating physical ontological limits of technological civilization. Concepts such as "Invisible Load," "Flux," "Metabolic Dignity," "Sovereignty Gap," and "Audit" represent research framework-specific definitions. Model verification requires further measurement campaigns and critical review.

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# II. GENESIS – ORIGINS OF THE RESEARCH MODEL

## II.1 Shock of Physical Reality – Modeling System Collapse

[HYPOTHESIS] Model origins lie not in theoretical construction but empirical observation: socio-ecosystem collapse never occurs abruptly but results from cumulative invisible flux loadings.

[PROTOCOL] Research framework suggests identifying measurable precursors to critical events (forest fire, lake eutrophication, landscape regeneration failure) prior to visible manifestation. EFU model hypothesizes these phenomena are quantitatively modellable with appropriate flux indicators.

## II.2 Structural Failure – Lessons from Political and Economic Experiments

[HYPOTHESIS] Political-economic experiments of the 2010s-2020s (elections, carbon markets) represent data collection phases demonstrating limitations of current one-dimensional metrics (money, CO<sub>2</sub>-equivalent).

[HYPOTHESIS] Carbon credit markets empirically demonstrated that monetary abstraction cannot solve physical problems, only displace or obscure them.

## II.3 Quantitative Ontology of Life – Synthesis

[HYPOTHESIS] Central model thesis: technological dominance (particularly AI) induces novel "metabolic climate change" affecting not only ecological but cognitive and sovereignty fluxes.

[AXIOM] EFU ontological principle: life constitutes a network of physically measurable flux systems, its ontological status independent of moral or ideological interpretations.

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## III. INVISIBLE LOADINGS – RESEARCH MEASUREMENT MATRIX

### III.1 Concept of "Invisible Load"

[HYPOTHESIS] Research model defines "Invisible Load" as physical, cognitive, and sovereignty fluxes that:

- do not appear in financial ledgers
- cannot be offset with CO<sub>2</sub>-equivalents
- directly reduce system resilience

**Model Axiom:** [AXIOM] "What is not measurable can be exploited without limits."

### III.2 Limitations of Carbon Logic

[HYPOTHESIS] Traditional CO<sub>2</sub>-based calculations are one-dimensional, ignoring:

- constant digital infrastructure energy flux
- AI cognitive displacement effects
- water/nutrient/material cycle distortions
- human decision autonomy erosion

### III.3 EFU Invisible Load Matrix – Research Reference Values

Dimension	Measures	Key Question	Model Reference Value
EFU-E	Energy Flux	How many humans' annual energy extracted?	3,154 MJ/year/person [HYPOTHESIS]
EFU-H <sub>2</sub> O	Freshwater Flux	How many humans' water security affected?	1,460 m <sup>3</sup> /year/person [HYPOTHESIS]
EFU-N/P	Nutrient Cycles	How much biosphere regeneration shortened?	15,625 EFU-N/year [HYPOTHESIS]
EFU-C	Cognitive/Sovereignty	How many humans' autonomy eroded?	2,500 persons/year [HYPOTHESIS]
RACF	Biological Carbon Flux	How many human metabolisms represented?	526 kg CO <sub>2</sub> /year/person [PROTOCOL]

**Note:** All EFU reference values subject to research calibration, requiring independent measurement series for validation. [HYPOTHESIS]

## III.4 Institutional Example – AI Trading System (Research Case Study)

[HYPOTHESIS] Modeled flux footprint of 1 MW AI trading system:

Metric	Value	Human Equivalent
EFU-E	61,320 EFU-E/year	Energy of 61,320 persons
EFU-H <sub>2</sub> O	15,000 EFU-H <sub>2</sub> O/year	Water supply of 15,000 persons
EFU-C	~2,500 autonomy/lock	Decision rights of 2,500 persons
Sovereignty Gap	+41,320 EFU-E	Regional allocation: 20,000 EFU-E/year

**Interpretation:** [HYPOTHESIS] Model suggests "EFU-Deficit" (Level 3) state, accumulating physically insolvent metabolic debt.

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## IV. ARGUMENT MAP – CRITICAL ATTACK POINTS

**Premise A:** [AXIOM] All socio-technical systems fundamentally operate through physical fluxes (E, H<sub>2</sub>O, N/P, C).

**Premise B:** [HYPOTHESIS] When Invisible Load > regional biocapacity (SS > 0), not "unsustainability" but **physically insolvent** state emerges.

**Conclusion C:** [HYPOTHESIS] EFU-based quantitative ontology can serve as tool for measuring Invisible Loadings and restoring physical sovereignty.

**Logical Chain:** A + B → C

**Attack Points:** Calibration (A), regional capacity estimation (B), correlation with empirical outcomes (C).

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## V. EPISTEMOLOGICAL APPENDIX (EA-1.0)

### V.1 Falsifiability

[PROTOCOL] Critical testing points:

1. **Flux Calibration:** If EFU-E/H<sub>2</sub>O/N/P/C reference values cannot be validated within ±10% against independent measurements, model parameterization rejectable.
2. **Sovereignty Gap:** If SS ≫ 0 systems show no measurable ecological/social degradation, SS concept invalidated.
3. **Invisible Load:** If matrix fails to correlate with measurable resilience decline, multidimensional model erroneous.

## V.2 Uncertainty Sources

[HYPOTHESIS]

- Regional biocapacity estimation precision
  - Cognitive/sovereignty flux operationalization
  - Data integrity (institutional transparency gaps)
  - Interdisciplinary measurement methodology maturity
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## VI. CLOSING STATEMENT – RESEARCH CONCEPT

[HYPOTHESIS] EFU White Paper represents **research concept**, not standard, investigating physical ontological limits of technological civilization. Purpose: hypothesis formulation and render Invisible Loadings measurable.

**Next Steps:** Pilot measurements (data centers, AI systems), case studies, model calibration.

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**Declaration:** Conceptual framework, quantitative model, and interpretations remain author's full responsibility. AI tools used for editing and structural support.

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**Open for critical review.** Expert feedback requested on model calibration, falsification tests, and interdisciplinary validation.

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