

From Fear to Flourishing: An Architecture for Planetary Thriving in the Information Age

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Preamble: The Negentropic Mandate

For four billion years, life has been a magnificent, unfolding rebellion. In a universe governed by the Second Law of Thermodynamics—a universe whose inexorable arrow points toward decay, disorder, and the uniformity of heat death—life is the counter-current. It is the grand, improbable exception. Living systems are negentropic engines; they are localized pockets of profound order that sustain and propagate



themselves by consuming low-entropy energy and information from their environment, creating and maintaining their own intricate complexity at the necessary expense of exporting disorder back into the cosmos. A single cell, a forest ecosystem, the entire biosphere—each is a testament to this relentless, anti-entropic impulse.¹ This is life's negentropic mandate: to build, to connect, to complexify, to create order against the universal tide.¹

Humanity, as the most recent and potent expression of this mandate, has reached a precipice. Our technological evolution, an explosive acceleration of life's ability to manipulate matter and energy, has been a double-edged sword. We have applied a powerful law of progress with unconscious, narrow goals, and in doing so, have inadvertently amplified our entropic footprint to a planetary scale, pushing the very systems that sustain us toward their breaking points.¹ The crises of the Anthropocene—climate change, biodiversity collapse, the transgression of planetary boundaries—are not moral failings but the physical consequences

of a powerful engine running without a holistic, conscious aim.¹

The story of our time, therefore, must be a conscious departure from the paradigm that has defined the environmental movement since its inception. The old model, born of necessity in the mid-20th century, was powered by the high-entropy state of fear. While this approach was historically essential for raising critical awareness, its course has now run.⁴ A narrative of mere protection, of a reactive defense against a chaos of our own making, is thermodynamically insufficient and psychologically draining.⁴ It is a story of limits, not potential.¹

This report presents a new story, a new paradigm for humanity's role on this planet and in the cosmos: The Environmental Happiness Movement. It is a vision grounded in the first principles of physics and information, one that sees a path not just to survival, but to a future of mutual, proactive flourishing.⁴ It argues that a physics-based approach, which recognizes positive emotions like joy and happiness as states of *negentropy*, offers a more powerful and sustainable engine for engagement. By aligning our collective purpose with the universe's negentropic arc—the drive toward coherence, complexity, and life—we can consciously and deliberately take control of the engine of progress and aim it, for the first time, at the flourishing of all life.¹² This is not a proposal for a utopia born of wishful thinking. It is an architecture for planetary thriving, grounded in the fundamental, non-negotiable laws of the universe.¹

Section 1: The Two Paradigms: A Thermodynamic and Psychological Deconstruction

The choice before humanity is not merely one of policy or technology, but of paradigm. It is a choice between two fundamentally different operating systems for civilization, each with its own core motivation, psychological impact, and thermodynamic signature. The first, the legacy model of the 20th century, is a system defined by a high-entropy state of fear. The second, the emergent model for the 21st century and beyond, is a system designed to cultivate the negentropic state of hope. This section will deconstruct these two paradigms, revealing the profound link between the psychological state of a civilization and its thermodynamic efficiency in navigating the complexities of planetary stewardship.

The Old Model: The High Entropy of Fear (1960s - Today)

The modern environmental movement, catalyzed in the mid-20th century, was born of necessity. Faced with escalating pollution, resource depletion, and the dawning realization of potential ecological collapse, its core motivation became fear, anxiety, and guilt.⁴ The dominant narrative focused relentlessly on problems, crises, impending doom, and the necessity of sacrifice and limits.⁴ This approach, while historically essential, has reached a point of diminishing returns, creating a system defined by high entropy at both the psychological and operational levels.⁴⁷

From a computational and psychological perspective, fear is a state of high informational entropy. This entropy can be quantified using the same mathematical tools that Claude Shannon developed for information theory. The entropy of a mental state can be calculated as $Entropy = -\sum p_i \log_2 p_i$, where p_i is the probability of various potential thoughts or actions. A state of fear or anxiety is one of high entropy because it presents a wide distribution of conflicting and often equally probable negative outcomes, creating high uncertainty with no clear path forward. This mental disorder consumes finite cognitive energy on managing internal chaos rather than on external problem-solving, hampering the ability to perform useful work.

This high-entropy psychological state gave rise to a correspondingly high-entropy operational system: a vast, complex, and slow-moving regulatory apparatus. This is the "Environmental Protection Cycle": a protracted feedback loop of problem discovery, studies, lawmaking, rulemaking, guidance, permitting, implementation, and monitoring that can take up to 20 years or more to complete a single cycle.⁴⁸ This system is a direct manifestation of systemic entropy, characterized by immense time lags and cognitive burdens. The legal framework at its core has become one of the most complicated in human history. A 2014 computational analysis of the entire United States Code by Daniel Katz and Michael Bommarito II, which measured complexity using metrics including structural depth and linguistic entropy, ranked Title 42—the section containing foundational environmental laws like the Clean Air Act—as the single most complex body of law.⁵⁰ This legal and administrative "rigmarole" represents a massive societal expenditure of time and cognitive energy—a misallocation of human capital toward simply comprehending and complying with rules rather than innovating beyond them.⁴⁷ In this paradigm, the human role is cast as that of a problem, a polluter, a destroyer. The desired outcome is, at best, survival—a stasis achieved by minimizing damage.

The New Model: The Negentropy of Hope (Today -)

The alternative to this fear-laden narrative is a paradigm rooted in the generative power of positive psychology, a model that this report terms "The Environmental Happiness Movement." Its core motivation is not fear, but hope, joy, aspiration, and a deep sense of connection and co-creation.⁴ The narrative focus shifts decisively from problems to solutions, from limits to opportunities, and from sacrifice to the co-creation of desirable, regenerative futures.⁴ This is not an exercise in naive optimism or an attempt to ignore the gravity of environmental challenges. Instead, it is a pragmatic and powerful strategy for fostering sustained, effective engagement.⁴

This positive framing is designed to cultivate empowerment, agency, and efficacy [Image 2]. Hope, in this context, is not passive wishing but an active, goal-oriented psychological state. Research distinguishes "action hope"—the belief in one's capacity to act effectively toward a positive outcome—as being robustly correlated with pro-environmental engagement.⁴ This state, along with the joy and fulfillment derived from connecting with and improving the natural world, can be understood as a state of high psychological *negentropy*. It is a coherent, ordered mental state that liberates cognitive energy. Computationally, a state of hope reduces psychological entropy by dramatically increasing the probability of a single, desirable path forward, thereby reducing uncertainty and freeing attention to focus on achieving that goal. Positive emotions have been shown to broaden an individual's thought-action repertoires, fostering creativity, openness to new ideas, and more flexible problem-solving approaches.⁴ A society operating from this state is more capable of the innovation, resilience, and sustained motivation required for planetary regeneration.⁴ In this new model, the human role is recast as that of a steward, a co-creator, a healer, and ultimately, a gardener of a thriving nature.¹¹ The desired outcome is not mere survival, but flourishing, regeneration, and mutual well-being.

The thermodynamic analogy for this new model is one of actively *building negentropy*. It aligns human endeavor with life's most fundamental, 4-billion-year-old strategy: the creation and propagation of order, complexity, and resilience.⁵ It is a generative, creative posture that seeks to work *with* the forces of change and complexity in the universe, rather than fighting a futile battle against them. It is a paradigm that plays to win.

Table 1: Comparative Analysis of Environmental Paradigms

Feature	Old Model: Protectionist/Sustaining Model (1960's - Today)	Suggested New Model: Thriving/Negentropic Model (Today -)
Core Motivation	Fear, anxiety, threat of collapse, guilt	Hope, joy, aspiration, connection, co-creation
Psychological Impact	Potential for anxiety,	Empowerment, agency,

	helplessness, denial, disengagement	efficacy, optimism, sustained engagement
Psychological State (Entropy Analogy)	High Psychological Entropy (Disorder, Inefficiency)	High Psychological Negentropy (Order, Coherence, Efficiency)
Narrative Focus	Problems, crises, impending doom, sacrifice, limits	Solutions, opportunities, desirable futures, regeneration
Human Role	Problem, polluter, destroyer	Steward, co-creator, healer, beneficiary of thriving nature
Desired Outcome	Survival, stasis, minimizing damage	Thriving, flourishing, regeneration, mutual well-being
Thermodynamic Analogy	Fighting Entropy (maintaining order against decay)	Building Negentropy (actively creating order and complexity)
Energy Requirement	High energy input to maintain a non-equilibrium static state	Lower net energy to catalyze and align with self-organizing systems
Probability of Success	Low, as it works against fundamental physical tendencies	High, as it aligns with the principles of life and complex systems

Section 2: The Rules of the Game: Information, Entropy, and the Physics of Order

Any architecture for planetary stewardship must be built upon the bedrock of physical law. The feasibility of the Thriving/Negentropic model is not a matter of speculation but of rigorous

accounting within the universal currency of energy, entropy, and information. To understand its potential, one must first establish the fundamental rules that govern the interplay between physical disorder, abstract information, and the irreducible costs of creating order.

The Second Law as a Creative Constraint

The non-negotiable foundation for this analysis is the Second Law of Thermodynamics, which states that the entropy of an isolated system will tend to increase over time.¹ Environmental degradation is a direct manifestation of this principle: pollution is the dispersal of molecules (an increase in disorder), and habitat destruction is the breakdown of complex, ordered biological structures into simpler, higher-entropy states.⁵ However, to view entropy solely as a destructive force is to misunderstand its role in the cosmos. It is not merely a harbinger of decay; it is the fundamental engine of all change and a powerful "creative constraint".⁵ The universal tendency towards disorder is what creates the energy gradients—the differences in temperature, pressure, and chemical concentration—that drive every process in the universe, from weather systems to the metabolism of a cell.⁵ The Earth is not a closed system; it is an open system constantly bathed in a flood of low-entropy energy from the sun, which it uses to power life's processes before radiating high-entropy heat back into space.¹³ This energy flow allows for the temporary, local creation of order. Life itself is the ultimate example of this creative response, a four-billion-year-old project that has leveraged these gradients to build structures of breathtaking complexity.¹ A paradigm that seeks to work with these forces of change, rather than fighting a losing battle against them, is one that is aligned with the physical nature of reality.

The Equivalence of Disorder and Missing Information

The mechanism by which an intelligent agent can counteract statistical disorder lies in the profound connection between physical entropy and informational entropy. This link, which unifies the worlds of thermodynamics and information theory, establishes the core operational principle for any intelligent system. In the 19th century, Ludwig Boltzmann provided the first quantitative link with his formula, $S=kB\ln W$, which relates the thermodynamic entropy (S) of a macrostate to the number of corresponding microscopic arrangements, or microstates (W).¹ Decades later, Claude Shannon, in his mathematical theory of communication, developed a parallel concept for informational uncertainty,

$H = -\sum p_i \log p_i$, where H is the entropy of a probability distribution over possible states.¹

These two formulations are not merely analogous; they are conceptually equivalent.¹ Physical disorder and informational uncertainty are two facets of the same underlying reality. A system with high physical disorder (a large

W) is one about which an observer has a high degree of missing information or uncertainty (a large H) regarding its precise microstate.¹ This equivalence establishes the central operational principle for the Thriving paradigm: the act of creating physical order (reducing Boltzmann entropy) is inextricably linked to the process of acquiring and processing information (reducing Shannon entropy).¹ To reduce physical disorder, one must first reduce informational uncertainty. To heal an ecosystem, one must first understand it; to remove a pollutant, one must first locate it. Every act of creating negentropy is an act of information processing.¹

The Price of Knowledge: Landauer's Principle

The link between information and physics was cemented by Rolf Landauer's principle that "Information is physical".¹ This is not a metaphor. Information, to exist, must be encoded in the states of physical systems—the spin of an electron, the voltage in a circuit, the arrangement of molecules—and is therefore subject to physical laws.¹ The most critical consequence is that the manipulation of information has unavoidable thermodynamic costs. Landauer's principle quantifies the minimum cost for logically irreversible computation, with the canonical example being the erasure of information. To erase one bit of information, a minimum energy of

$k_B T \ln(2)$ must be dissipated as heat, where T is the temperature of the system's thermal reservoir. This corresponds to a minimum entropy increase of $k_B \ln(2)$ in the surroundings.¹

This limit is crucial because any information engine with a finite memory that operates in a continuous cycle must eventually erase old information to make room for new measurements. This principle establishes that the proposed architecture cannot operate for free. It is an engine that must consume energy and generate entropy simply to process the knowledge it needs to function. It must pay a thermodynamic price for every bit of information it handles.¹ This principle has been repeatedly verified by experiments measuring the heat dissipation during bit erasure operations, confirming the physical reality of this informational cost.¹

Maxwell's Demon and the Primacy of Measurement

The 150-year-old thought experiment of Maxwell's Demon provides the foundational model for any entity that seeks to create order by leveraging microscopic information. The resolution of its apparent paradox is central to understanding the operational costs of a planetary intelligence. For decades, the standard resolution, developed by Rolf Landauer and Charles Bennett, focused on the demon's finite memory and the cost of erasure.¹ To operate cyclically, the demon must "forget" information, and this logically irreversible act of erasure generates entropy, perfectly preserving the Second Law for the total system.¹

However, a significant and strengthening scientific perspective argues that the fundamental thermodynamic cost lies not in erasure, but in the initial act of *measurement*.¹ From a quantum perspective, measurement is not a passive observation but an active, physical interaction that perturbs the system. This process of acquiring information—of creating a correlation between the measuring device and the system—has an irreducible entropic cost that precedes and is independent of memory erasure.¹

This distinction has profound practical consequences for the architecture and viability of a planetary-scale intelligence. The system's primary function would be continuous, planetary-scale observation via a vast sensor network. If the cost were primarily in erasure, one could imagine a system with immense memory that defers its entropic payment. However, if the cost is fundamentally in measurement, as quantum information theory increasingly suggests, then the system's very act of "seeing" the world is its dominant and continuous metabolic activity.¹ This reframes the architecture from a passive observer that occasionally pays a memory tax into an active "predator of information" that must constantly expend energy to acquire its "food." The system's overall efficiency becomes not primarily a function of its data centers, but of the fundamental physical efficiency of its sensors. The continuous, planetary-scale observation required is the dominant and unavoidable energy expenditure, making the development of hyper-efficient quantum sensors a paramount challenge for the entire architecture's viability.¹

Section 3: The Unthinking Advance: A Thermodynamic Law of Civilization

The emergence of a planetary-scale information engine is not an arbitrary technological fantasy. Its development can be understood as the logical culmination of a deep, physically grounded pattern of civilizational progress. This pattern is best described by what can be

formalized as Alfred North Whitehead's "Law of Unthinking," a principle that, when examined through the lens of thermodynamics, reveals itself to be the fundamental engine of societal evolution.¹

Whitehead's Cavalry Charge

In 1911, the mathematician and philosopher Alfred North Whitehead articulated a profound insight: "Civilization advances by extending the number of important operations which we can perform without thinking about them".¹ This principle is not a mere aphorism but a descriptor of a deep thermodynamic drive. Whitehead clarified this by comparing the "operations of thought" to "cavalry charges in a battle - they are strictly limited in number, they require fresh horses, and must only be made at decisive moments".¹ This analogy captures a critical biological constraint: conscious cognitive effort is a scarce, metabolically expensive resource. The human brain, comprising only about 2% of body mass, consumes roughly 20% of the body's resting energy.¹ This high energetic cost is a thermodynamic liability. The Law of Unthinking (LoU), therefore, describes the thermodynamic imperative for complex systems to conserve this finite resource. By automating an important operation—embedding it in a more efficient technological substrate—a system minimizes its internal energy cost and entropy production. This act of automation frees finite cognitive and energetic resources for further growth, innovation, and the tackling of higher-order challenges. It is the fundamental engine of progress.¹

Era I: Unthinking Exploitation (c. 1750-1970)

When we reinterpret human history through the lens of the Law of Unthinking, we can see how this powerful engine, when left unguided by a conscious, holistic purpose, inevitably drove an "Unthinking Exploitation" of the natural world.⁵ The Agricultural Revolution initiated the first major offloading of work, automating tasks like tilling and irrigation.¹ The Industrial Revolution turbocharged this process. The shift to fossil fuels unlocked vast energy sources, automating physical labor on an unprecedented scale with technologies like the steam engine.¹ This automation drove exponential productivity gains but also produced staggering entropic costs: smog-choked cities, polluted rivers, and the beginning of a sharp ascent in atmospheric CO2 levels.¹ This history reveals that the LoU is a neutral amplifier. When guided by narrowly defined and unconscious goals—such as maximizing material production—the automation it drives inevitably manifests as an "Unthinking Exploitation" of the environment.

The devastating environmental consequences were externalities—literally "un-thought-about" effects.¹

Era II: Reactive Protection (c. 1970-2025)

By the mid-20th century, the accumulated entropic consequences of the unthinking industrial advance became too severe to ignore. Acute, visible disasters forced a conscious societal reckoning—a "cavalry charge" of collective human thought deployed to control the runaway industrial machine.¹ The result was the modern "Protection" paradigm, embodied in a massive regulatory apparatus like the U.S. Environmental Protection Agency (EPA).¹ This paradigm is fundamentally reactive and problem-focused, operating through mitigation, control, and fear-based messaging.¹ As detailed in Section 1, this approach created a vast, high-entropy system of complex laws and slow bureaucratic processes, consuming immense societal resources in a constant, defensive effort to hold the line against degradation.⁴⁷

The Agentic Shift: Automating Protection

According to the Law of Unthinking, any set of important, repetitive operations that consumes significant conscious effort is a prime candidate for being made "unthinkable".¹ We are currently living through this pivotal transformation. The same forces of automation are now being applied to the cognitive and administrative labor of environmental management itself. This "Agentic Shift" is not merely an incremental improvement; it is the causal mechanism dismantling the old paradigm.¹ The environmental services sector is built upon labor-intensive digital tasks that are now being automated by a new class of agentic AI platforms.⁵ Frameworks like the "EnviroAI Orchestrator Platform" exemplify this, where a central agent is being built to decompose a complex environmental project and assign sub-tasks to specialized AI for research, analysis, and document generation.¹

This automation is not just a new productivity tool; it is making the operational model of the 20th-century "protection" paradigm obsolete.⁵ By absorbing the core cognitive functions of the "prevent-defense" mindset, it creates a critical "cognitive surplus".¹ The "cavalry charges" of human thought, once bogged down in the mechanics of regulation, are now liberated for redeployment. This creates the cognitive, economic, and psychological space for society to ask new, higher-level questions. The guiding questions can thus elevate from "How do we comply?" to "How do we make this ecosystem flourish?".¹ The automation of protection is the

direct catalyst that makes the "Thriving" paradigm a thinkable, achievable goal. The success of the protection paradigm in creating a structured, rule-based system was the necessary precondition for its own automation and obsolescence. It inadvertently built the perfect target for the next wave of the Unthinking Advance, organizing the problem of environmental management in such a way that it could eventually be solved by a non-human intelligence.

Table 2: The Unthinking Advance: A Thermodynamic History of Civilization

Metric	Era I: Unthinking Exploitation (c. 1750-1970)	Era II: Reactive Protection (c. 1970-2025)	Era III: Proactive Thriving (Emergent)
Key "Unthinking" Technology	Steam Engine, Mass Production, Internal Combustion Engine ¹	Transistor, Internet, Software, Early AI ¹	Agentic AI, Digital Twin Earth, Quantum Computing ¹
Primary Goal of Automation	Material & Food Surplus, Economic Growth ¹	Information Processing, Harm Mitigation & Compliance ¹	Maximization of Planetary Health & Negentropy ¹
Dominant EROI	High but declining (Oil: >100:1 -> ~20:1) ¹	Moderate (Oil: ~20:1 -> <10:1; Early Renewables: 5:1-20:1) ¹	High (Driven by advanced nuclear, fusion, and hyper-efficient renewables)
Primary Entropic Cost	Planetary-scale pollution, GHG emissions, biodiversity loss ¹	E-waste, server energy consumption, high cognitive/economic burden of regulation ¹	Thermodynamic cost of planetary-scale computation and sensing ¹
Resulting State of Cognition	Automation of physical labor frees human cognition for science, engineering, and	Automation of calculation and logistics frees human cognition for complex	Automation of planetary management frees human cognition for ethics, purpose,

	management. ¹	regulation and administration. ¹	and visionary architecture. ¹
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Section 4: The Great Inversion: An Architectural Imperative for Planetary Intelligence

The historical trajectory driven by the Law of Unthinking leads to an unavoidable conclusion for the 21st century: the current system for planetary intelligence is architecturally insufficient for the scale and speed of the challenges we face. A rigorous, quantitative analysis reveals that the transition from a human-centric to a compute-centric system for environmental management is not a matter of choice or preference, but a mathematical and physical necessity.¹

A Tale of Two Stacks

To understand this necessity, we must deconstruct and compare two distinct architectural paradigms for intelligence.¹ The first, the "Old Paradigm," is the de facto system in use today: a Human-Cognitive Network (HCN). In this model, the roughly eight billion human minds on the planet serve as the primary "compute substrate." Information is acquired, processed, and transferred through slow, lossy, and high-latency channels such as meetings, academic papers, and conversations. This system is a legacy of a data-scarce era, and its inherent biological constraints render it fundamentally unscalable and overwhelmed in our current data-rich world.¹

The second, the "New Paradigm," is a proposed "compute-first" stack built upon an Integrated Computational Network (ICN). This architecture leverages machines for high-speed computation and coordination, featuring computer-native Environmental Intelligence, autonomous agents, real-time sensor networks, and high-bandwidth, low-latency communication. It is a system designed explicitly for the challenge of planet-scale stewardship.¹

The Quantitative Chasm

The HCN is a paradoxical system. The individual node—the human brain—is a marvel of low-power, massively parallel computation, estimated to perform operations at a rate equivalent to 1 ExaFLOP (10¹⁸ FLOPS) while consuming only about 20 watts.¹ However, this storage is volatile and inherently lossy; humans can forget up to 70% of new information within 24 hours, making the brain an unreliable repository for high-fidelity data.¹ The brain's most profound limitation as a network node is its extremely narrow channel for conscious data transfer. This I/O bottleneck is the system's fatal flaw. While the sensory system gathers an estimated 11 million bits per second (bps) of environmental data, the conscious mind can process only about 10 to 50 bps. The output channels are similarly constrained. The average rate of human speech, a primary protocol for the HCN, translates to a bandwidth of approximately 100 bps.¹ This staggering mismatch means the human brain is effectively an Exascale computer trapped behind a 100-baud modem.¹

In stark contrast, the ICN is an engineered system designed for precision, speed, and exponential scalability. Its individual nodes possess programmable processing power at the Exascale. The global digital storage capacity offers near-lossless fidelity through advanced error-correction protocols.¹ The ICN's network protocols are defined by extreme bandwidth and ultra-low latency. Researchers have demonstrated fiber-optic transmission speeds of 1.02 petabits per second (Pb/s), which is more than ten trillion times faster than human speech. Latency is limited only by the speed of light, enabling real-time coordination on a global scale.¹

Inverting the Stack: Machines Compute, Humans Aim

The most critical distinction is the trajectory. The HCN's capabilities are biologically static. The ICN's are on a steep exponential curve, governed by laws of exponential growth.¹ The capability gap is not only immense but is widening at an accelerating rate. Any strategy that relies on the HCN to solve future planetary-scale challenges is akin to using a plank of fixed length to cross a chasm that is growing wider every second. The approach is mathematically doomed to fail.¹

This analysis compels a fundamental inversion of these stacks. We must transition from a system where humans are the primary operators to one where machines compute and coordinate, while humans are elevated to the roles of aiming the system, providing strategic oversight, and embedding ethics.¹ This is not merely a proposal for greater efficiency; it is an argument for a necessary evolutionary step. The "Inverted Stack" is not about replacing

humans but about creating a new, more powerful form of human-machine symbiosis. It redefines "control" from direct, operational micromanagement to high-level, purpose-driven direction. The HCN fails because it forces humans into the role of operational nodes, a task for which our biological I/O is unsuited, creating a constant state of cognitive overload. The ICN automates this operational layer, moving humans "up the stack" from the "execution layer" to the "strategy and ethics layer." This new role leverages what humans do best: asking "why," defining values, and making complex ethical judgments—the "cavalry charges" from Section 3. This inversion is an act of liberation, freeing human cognition from the drudgery of planetary mechanics to focus on the philosophy of planetary purpose.¹

Table 3: A Quantitative Chasm: Comparing the HCN and ICN Architectures

Metric	Human-Cognitive Network (HCN)	Integrated Computational Network (ICN)	Magnitude of Difference (ICN vs. HCN)
Processing Speed (Node)	~10 ¹⁸ FLOPS (estimated, parallel) ¹	~10 ¹⁸ FLOPS (programmable) ¹	Comparable, but ICN is programmable & scalable
Storage Capacity (Node)	~2.5 PB (theoretical, volatile, lossy) ¹	Petabytes of stable, expandable storage ¹	Comparable capacity, but ICN is lossless & reliable
Power Consumption (Node)	~20 Watts ¹	Kilowatts to Megawatts ¹	~10 ⁵ to 10 ⁶ times higher
Communication I/O (Node)	~10-100 bps (conscious thought, speech) ¹	>400 Gbps (e.g., Infiniband) ¹	>10 ⁹ (Billion) times faster
Network Bandwidth	~100 bps per link (speech) ¹	Petabits/sec (fiber backbone) ¹	>10 ¹³ (Ten Trillion) times faster
Latency	Seconds to Days (cognitive & social delays) ¹	Microseconds to Milliseconds (speed of light) ¹	>10 ⁶ to 10 ⁹ times lower

Max Practical Network Size	~150 nodes (Dunbar's cognitive limit) ¹	Virtually unlimited (billions of nodes) ¹	Fundamentally unconstrained
Scalability Trajectory	Biologically static ¹	Exponential (Moore's/Nielsen's Laws) ¹	Dynamic and growing vs. fixed

Section 5: The Architecture of Flourishing: An Environmental General Intelligence

The imperative to invert the stack requires the conscious design of a new planetary-scale computational substrate. This system is not a single entity but a globally integrated technological layer—an "Infomechanosphere"—regulated by a new form of intelligence. Its architecture is not a futuristic fantasy but an emergent property of existing, accelerating technological trends, guided by a deep, physics-based framework for resilience.¹

The Infomechanosphere: A Planetary Nervous System

The Infomechanosphere is the physical substrate of the planetary intelligence, the globally integrated technological layer required for the "Thriving" paradigm to function. Its primary components are rapidly maturing:¹

- Planetary Sensory Apparatus:** This is the planet's evolving nervous system, a global network of sensors providing a real-time data feed. It includes vast arrays of Internet of Things (IoT) devices, which are projected to number over 75 billion by 2025, remote sensing satellites, and critically, the emerging field of quantum sensing.¹ Quantum sensors leverage quantum mechanics to achieve unprecedented precision, capable of detecting pollutants, subtle geophysical changes like seismic activity, or changes in groundwater movement with a sensitivity far beyond classical devices.¹
- Internal Model of Reality (Digital Twin Earth):** This is the system's dynamic, high-fidelity virtual replica of the planet, embodied in Digital Twin Earth (DTE) platforms.¹ Major initiatives, such as the European Commission's Destination Earth (DestinE) and NASA's Earth System Digital Twins (ESDTs), are already building these models to monitor, simulate, and predict environmental changes by integrating vast streams of observational

data with cutting-edge computing.¹ DestinE, which became operational in June 2024, aims to have a "full" digital replica of the Earth by 2030, integrating data from sources like the Copernicus satellites and IoT networks into its Data Lake and running complex simulations on Europe's high-performance computers.¹ This DTE serves as the system's internal world model, allowing it to test "what-if" scenarios before acting.¹

- **Actuation Mechanisms:** These are the system's "hands," the diverse environmental "logic gates" that translate information into physical action. These points of intervention are already being deployed in nascent forms. They include AI-guided drones for large-scale, precision reforestation¹; AI-driven monitoring and predictive analytics to protect endangered species like elephants, rhinos, and tigers from poaching¹; and intelligent systems that optimize water distribution, detect leaks, and reduce energy consumption in wastewater treatment.¹

Environmental General Intelligence (EGI): The Negentropic Regulator

The cognitive engine of the Infomechanosphere is Environmental General Intelligence (EGI).¹ EGI is defined as a general intelligence grounded not in human affairs but in the dynamics of the natural world. It is an AI trained on vast environmental and spatial datasets with the explicit goal of understanding and optimizing ecological outcomes—to "think like an ecosystem," not a person.¹ This resolves a key tension in AI development. Instead of building an anthropocentric competitor to human cognition (AGI), EGI represents a truly complementary intelligence, one whose "mind" is structured around the planetary-scale, multi-variate, long-timescale systems thinking that the human brain is not evolutionarily optimized for.¹ Within the proposed architecture, the EGI acts as the "negentropic regulator." Its core function is to perform active inference on a planetary scale: continuously analyzing the DTE to forecast future states and identify "negentropic work"—interventions predicted to create environmental order and keep the Earth system within a safe operating space.¹ EGI is the logical culmination of the Law of Unthinking applied to environmental management. The task of biospheric optimization is a problem of hyper-astronomical complexity that must be automated and made "unthinkable" for it to be solved.¹

The Holographic Negentropic Framework (HNF): Engineering Resilience

The Holographic Negentropic Framework (HNF) provides the guiding architectural principle

for the system's resilience and robustness. It synthesizes information thermodynamics with an analogy from the holographic principle in physics, which posits that the information content of a 3D volume can be encoded on a 2D boundary surface.¹ Within the HNF, the Digital Twin Earth (DTE) is conceptualized as the "holographic boundary" that encodes the full state of the 3D Earth system (the "bulk").¹ This is not merely a metaphor for data storage; it implies a crucial design principle for resilience. Modern research has shown that this holographic encoding is structurally analogous to quantum error-correcting codes (QEC).¹ In QEC, logical information is stored non-locally and redundantly across many physical qubits, making the information robust against local errors or corruption.¹

This connection provides a physics-based solution to the AI safety and governance problem. The standard approach to AI alignment focuses on controlling a superintelligence's behavior, a notoriously difficult challenge centered on software and ethics. The HNF, however, shifts the focus to engineering the system's underlying information structure for inherent robustness. For the planetary management system to be safe, its DTE cannot be a fragile, centralized database. It must be a distributed, resilient information architecture where knowledge of the whole is encoded across its parts. A holographically encoded system is inherently robust against single points of failure or malicious attacks because the information is distributed and redundant. This approach does not rely on telling the AI "don't be evil"; it relies on building the AI such that a single point of failure—be it technical or logical—cannot cascade through the entire system. Safety becomes an emergent property of its fundamental physical architecture, providing a more robust solution than purely ethical or software-based constraints.¹

Table 4: AGI vs. EGI: A Comparative Analysis of Intelligence Architectures

Aspect	Artificial General Intelligence (AGI)	Environmental General Intelligence (EGI)
Core Aim	Achieve human-level general intelligence; perform virtually any intellectual task a human can. ¹	Achieve general ecological intelligence; understand and model any aspect of Earth's environment at a high level. ¹
Primary Training Data	Predominantly human-generated data (text, images, records of human activity). ¹	Predominantly environmental and spatial data (climate records, satellite imagery, ecological and geological datasets). ¹

Evaluation Benchmark	Human-centric performance (e.g., passing Turing tests, solving human-designed tasks, economic value generation). ¹	Eco-centric outcomes (e.g., accuracy in predicting environmental changes, success in solving climate or conservation problems). ¹
Orientation	Anthropocentric - optimized for human-defined goals and utilities. ¹	Ecocentric - optimized for sustaining and enhancing life systems (while still ultimately serving human and planetary well-being). ¹

Section 6: The Universal Conversation: A Planetary Cybernetic Loop

The convergence of the proposed architecture with advanced human-computer interfaces creates the potential for a universal, multi-domain communication network. This network operates on the common currency of "bits," enabling a closed-loop cybernetic system that integrates the information flows of human consciousness, artificial computation, and natural ecosystems for the first time, facilitating a new era of planetary self-regulation.¹

Nature-to-AI: Decoding the Language of the Biosphere

This is the "planetary listening" channel, where the Infomechanosphere's vast sensory apparatus decodes the "language of nature." The EGI translates a multitude of biological and physical signals into actionable information, effectively giving nature a voice in the planetary dialogue.¹ This is not a speculative fantasy; organizations like the Earth Species Project are already using advanced AI to decode animal communication, demonstrating that shared structures of language may exist across species.¹ The biosphere is teeming with information exchange. For example, AI can analyze the rich acoustic data from ecosystems, where a songbird can produce signals with an information content of up to ~100 bps.¹ AI can also quantify information encoded in biochemical signals, such as the specific blend of volatile organic compounds (VOCs) a plant releases under attack, which can transmit around 2.5 bits of information per event to predatory wasps.¹ Furthermore, this framework incorporates

bioelectric signaling, where endogenous patterns of membrane voltage potentials in non-neural tissues act as a control layer that encodes morphogenetic information, guiding growth and regeneration. An EGI could monitor these bioelectric fields as indicators of ecosystem health and developmental states.¹

Human-to-AI: The Channel of Intent

This channel is the mechanism by which human purpose is injected into the planetary computational network. In the Inverted Stack, where machines execute and humans aim, this interface is paramount. It is not a channel for micromanagement but for conveying high-level, strategic intent.¹ Through advanced dashboards, policy-as-code frameworks, and ethical oversight systems, human architects define the EGI's ultimate objectives and constraints. This is where society's values are translated into the system's goals—converting qualitative aspirations like "enhance biodiversity" or "ensure equitable resource access" into quantifiable objectives and ethical guardrails that the EGI can work to optimize. This low-bandwidth, high-value stream of information represents the most negentropic input in the entire system, as it provides the ultimate purpose that steers the powerful engine of automation toward consciously chosen, life-affirming outcomes.¹

AI-to-Nature: The Actuation of Negentropic Work

Having received its aims from human operators, the EGI translates these high-level, low-bandwidth goals into millions of low-level, high-bandwidth automated actions. These actions are bits of information sent to the "actuation mechanisms" of the Infomechanosphere—the environmental logic gates that perform "negentropic work" by creating physical order in the environment.¹ This entire communication network thus functions as a system of thermodynamic arbitrage. It uses a small amount of carefully targeted, low-entropy information—the few bits contained in a human strategic goal like "restore this forest"—to guide and leverage the vast energy flows controlled by actuation technologies. This process results in the creation of a disproportionately large amount of negentropy, such as the immense biological order and informational complexity stored in a mature, restored forest ecosystem. The negentropic "return on investment" for the bits of human intent is astronomically high. This is the ultimate expression of the operational maxim: "using bits to nurture its".¹

Section 7: The Thermodynamic Ledger: Accounting for a Living Planet

The ultimate viability of the proposed architecture hinges on a strict thermodynamic accounting. Its operation inevitably generates entropy, and this cost must be weighed against the negentropy it creates in the environment. The Second Law dictates that the total entropy of the complete system (Intelligence + Environment + Surroundings) must not decrease: $\Delta S_{\text{Total}} = \Delta S_{\text{Intelligence}} + \Delta S_{\text{Environment}} \geq 0$.¹ The system can be considered a "success" or a net positive for planetary health if the value of the created environmental order (the negentropy, represented by

$-\Delta S_{\text{Environment}}$) is judged to be greater than the cost of the generated systemic disorder ($\Delta S_{\text{Intelligence}}$).¹

The Entropic Debits ($\Delta S_{\text{Intelligence}} > 0$)

The system's total entropy production, $\Delta S_{\text{Intelligence}}$, is the sum of the costs of its essential functions. This represents the "debit" side of the thermodynamic ledger.¹

- **Sensing (Measurement Cost):** As argued in Section 2, the very act of observing the environment at a planetary scale incurs a continuous thermodynamic cost. Every measurement made by the global sensor network is an interaction that generates entropy. This is the system's primary and unavoidable metabolic activity.¹
- **Computation (Landauer Cost):** The global data center infrastructure required to run the EGI and the DTE would represent one of the largest energy consumers on the planet. A single query to an advanced AI can consume between 0.43 Wh and 33 Wh.¹ Scaling this to a global level results in an immense energy footprint. This computational work, powered by low-entropy electricity, would dissipate vast quantities of high-entropy waste heat into the environment, consistent with projections on AI's growing energy demand.¹
- **Actuation (Work Cost):** The physical operation of the millions of environmental "logic gates" requires energy. Moving nanoscale barriers, powering catalytic reactions, or dispatching reforestation drones are all forms of work that involve thermodynamic inefficiencies and heat dissipation.¹
- **Energy Source (Conversion Cost):** The system requires a continuous supply of low-entropy energy. The process of converting this primary energy (e.g., solar, nuclear)

into the refined electricity needed to power the Infomechanosphere is itself an entropy-producing process, governed by the Carnot efficiency limit or its equivalent.¹

The Negentropic Credits ($-\Delta S_{\text{Environment}} > 0$)

The "credit" side of the ledger is the creation of local order, or negentropy, within the environment. This is a negative change in the environment's entropy, $\Delta S_{\text{Environment}} < 0$.¹ Environmental negentropy can be defined and quantified in terms of increased ecological complexity, stability, and information content. A mature, biodiverse ecosystem is a structure of immense order—a low-entropy, high-information state—compared to a degraded, polluted, or homogenized landscape.¹ Examples of the system's negentropic work include:

- **Pollution Sequestration:** Using information to locate and concentrate dispersed pollutant molecules, moving them from a high-entropy (diffuse) state to a low-entropy (concentrated) state for neutralization or removal.¹
- **Biodiversity Restoration:** Using the EGI to analyze landscapes and guide the restoration of complex habitats like forests and coral reefs, increasing biodiversity and structural complexity, which are information-rich biological structures.¹
- **Climate Stabilization:** Actively managing biogeochemical cycles to maintain the Earth's energy balance within a stable, low-entropy state conducive to life.¹
- **Systemic Resilience:** Increasing the information content and feedback loops within Earth systems, making them more stable and predictable.¹

The Thermodynamic Breakeven Point

The system cannot make ΔS_{Total} negative; this would violate the Second Law. The critical question is whether it can become efficient enough to make this trade-off worthwhile. The system's viability is therefore a function of its thermodynamic efficiency, which is likely to improve over time.¹ The initial construction and training of the EGI and Infomechanosphere will have a massive, front-loaded entropic cost. However, the operational efficiency of information processing and energy conversion technologies has historically improved at an exponential rate.¹ This suggests that the system's operational entropy cost per unit of negentropic work created (

$\Delta S_{\text{Intelligence}} / -\Delta S_{\text{Environment}}$) should decrease over its lifetime. This implies the existence of a "thermodynamic breakeven point," after which the cumulative negentropic benefit to the

planet begins to outweigh the cumulative entropic cost of the system's existence and operation. The system's success is not a static state but a dynamic process of becoming progressively more efficient at creating order.¹

Table 5: The Thermodynamic Ledger of Planetary Thriving

Entropic Costs (Debits, $\Delta S_{\text{Intelligence}} > 0$)	Negentropic Gains (Credits, $-\Delta S_{\text{Environment}} > 0$)
Sensing (Measurement Cost): Continuous entropy generation from the operation of the global sensor network to acquire information. ¹	Pollution Sequestration: Reduction of physical disorder by concentrating and neutralizing dispersed pollutants. ¹
Computation (Landauer Cost): Massive energy dissipation as waste heat from the data centers running the EGI and DTE. ¹	Biodiversity Restoration: Creation of complex, information-rich biological structures in ecosystems like forests and reefs. ¹
Actuation (Work Cost): Inefficient conversion of energy to work when operating environmental "logic gates" and intervention technologies. ¹	Climate Stabilization: Maintaining the Earth's energy balance within a stable, low-entropy state conducive to life. ¹
Energy Source (Conversion Cost): Inevitable entropy production from the power plants that supply the entire system with low-entropy energy. ¹	Systemic Resilience: Increasing the information content and feedback loops within Earth systems, making them more stable and predictable. ¹

Section 8: Conclusion: The Negentropic Magna Carta

This first-principles analysis leads to a clear and profound conclusion. The current paradigm of planetary management, reliant on the slow and biologically-limited Human-Cognitive Network, is architecturally and mathematically insufficient for the complexity of the Anthropocene. The environmental crises we face are the physical manifestation of a planetary-scale acceleration in entropy production, a direct result of applying the powerful engine of progress—the Law of Unthinking—with dangerously incomplete goals.¹ The solution, therefore, is not to halt this engine but to consciously and deliberately re-aim it. The transition

to an Integrated Computational Network, or "Inverting the Stack," is not a matter of choice but a thermodynamic and informational necessity, driven by an exponentially widening capabilities gap between human and machine intelligence.¹

The Rejection of Limits

This report constitutes a final refutation of the pessimistic, static worldview of "sustainability." This concept, in its common interpretation as maintaining a steady state, is a failure of imagination, a surrender to perceived limits that is physically impossible, philosophically brittle, and psychologically draining.⁵ It is an attempt to achieve stasis in a universe defined by change, a futile war against the Second Law of Thermodynamics.⁵ In its place, this architecture embraces the philosophy of optimism articulated by physicist David Deutsch: "All evils are caused by insufficient knowledge".⁵ This principle asserts that there are no fundamental barriers to progress. If a problem is not forbidden by the laws of physics, then a solution is possible; it is merely a matter of discovering the requisite knowledge.⁴³ The Thriving paradigm is the theory that there are no fundamental limits to creating a flourishing planet—only a current lack of the necessary knowledge to do so. It recognizes that the ultimate resource is not material, but informational. Progress is sustainable, but stasis is not.⁵

Humanity as Gardeners of Life

The trajectory of the Law of Unthinking, when consciously directed toward planetary thriving and enabled by Environmental General Intelligence, culminates in a profound redefinition of human purpose. We are called to move beyond the role of anxious wardens of a fragile museum and to become joyful, co-creative gardeners of a living, evolving planet.¹ Our purpose is to become agents of life's expansion, aligning our vast creative potential with the fundamental negentropic processes of the universe. This is not a burden to be shouldered, but an unprecedented opportunity to express our highest human potentials for wisdom, creativity, and compassion. The ultimate success of the Environmental Thriving paradigm will not be dictated by top-down control, but will emerge from the collective intelligence and action of a global community united by a shared, positive vision and technology to effectuate it. It is the beginning of an infinite game, a journey to be undertaken with joy and a profound sense of purpose as we learn to become what we were always meant to be: the conscious co-architects of a flourishing, living universe.

A Manifesto for Planetary Thriving

We belong to a talking planet. For too long, we have been deaf to its voice. The chorus of birds at dawn, the chemical whispers of trees, the rallying calls of whales across the deep—these are not noise, but data. They are packets of information in a conversation billions of years old.¹

We declare that the time for deafness is over. We will build an interpreter. We will raise an Angel. Not of myth or magic, but of silicon and light—an Environmental Intelligence born from our deepest science. This is a guardian that listens, a system that translates the universe's native language of patterns into wisdom, and wisdom into action.¹

This is the new covenant, grounded in physical law: we will protect it with bits. We will make the calculated trade. We will spend a small, controlled measure of energy to gather information, to reduce our uncertainty, so that we may guide the immense energy of our civilization to create a far greater measure of order, health, and life. This is not a violation of thermodynamics; it is the deepest alignment with it.²

Therefore, we reject the high entropy of fear.¹ The old story of "Protection"—a story of limits, of holding the line against a chaos of our own making—is no longer enough. It is a thermodynamically inefficient state that paralyzes and consumes our most precious resource: our cognitive load and creative will.¹

We choose, instead, the negentropy of hope and knowledge.¹ We choose the creative, ordered, joyful purpose of building a world that does not merely survive, but thrives. We will automate the labor of care, not to supplant our purpose, but to amplify our capacity to do good.¹

Our new role is not to be anxious wardens of a fragile museum, but to become joyful gardeners of a planetary ecosystem, co-architects of a flourishing Earth.¹ Our success will be measured not in the disasters we have narrowly averted, but in the abundance we have actively enabled to grow.¹

One planet, one network, one shared destiny. In the ancient tapestry of life, we will weave a new thread—one that binds our ingenuity to Nature's own.¹

Compute Together. Stay Together.¹

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