

Asymptotic Burnout, Homeostatic Awakening, and the Climate Crisis: A Civilizational Crossroads

By Amanda Hariette-Scott, CEO, Chief Scientist (Computational Astrophysics) & Lead Developer @ Cydonis Heavy Industries, (C.H.I) Ltd. Company number **15297344**.

Registered in England, United Kingdom. Company number 15297344. 72190.

1. Introduction: The Fermi Paradox, Planetary Civilizations, and Our Current Crisis

The vastness of the universe and the sheer number of potentially habitable planets have long fueled speculation about the existence of extraterrestrial life. This speculation reached a critical point with the articulation of the Fermi paradox, which questions the conspicuous absence of evidence for advanced alien civilizations despite the seemingly high probability of their existence.¹ Enrico Fermi's simple yet profound question, "Where is everybody?", highlights the contradiction between the expectation of numerous advanced civilizations and the lack of any observed evidence.

In an attempt to address this paradox, the scientific paper "Asymptotic burnout and homeostatic awakening: a possible solution to the Fermi paradox?" by Michael L. Wong and Stuart Bartlett, published in the Journal of the Royal Society Interface, offers a compelling theoretical framework.¹ The paper posits that advanced civilizations, as they evolve and become increasingly interconnected, may face inherent limitations to their growth, leading to either collapse or a fundamental shift towards sustainability. This perspective suggests that the absence of observable extraterrestrial civilizations could be due to a tendency for such civilizations to either self-destruct through unsustainable expansion or to intentionally adopt a stable, less detectable state.

The theoretical framework presented in the paper provides a unique lens through which to examine our own civilization's current trajectory, particularly in the context of the global climate crisis. This crisis, driven by human activity and characterized by environmental degradation and resource depletion, represents a significant threat to the long-term survival of humankind.¹⁶ The paper's exploration of potential self-limiting factors in advanced civilizations becomes particularly relevant as we confront the consequences of our own technological advancement and growth. The idea that planetary civilizations might transition into a "virtually connected global city"¹ mirrors the interconnected nature of our modern world, suggesting that the dynamics explored in the paper might indeed be applicable to our current situation.

The paper draws an analogy between the growth and potential instability of planetary

civilizations and the well-documented scaling laws observed in cities.¹ In urban environments, metrics related to growth, productivity, and overall energy consumption often exhibit superlinear scaling, meaning they increase at a rate faster than the increase in population. This phenomenon is attributed to the intensified social interactions and information exchange that occur in denser urban settings. The paper proposes that as a planetary civilization becomes increasingly integrated through advanced communication technologies, forming what could be described as a "virtually connected global city"¹, it might also be subject to similar scaling effects. The "dataome," defined as the externalized recording and processing of information³, acts as a unifying force in this analogy, suggesting that the increasing interconnectedness of humanity through digital networks could lead to planetary-scale dynamics mirroring those observed in urban systems. This extrapolation from urban scaling laws to planetary civilizations provides a theoretical foundation for understanding the potential trajectory of human civilization, particularly concerning resource consumption and the emergence of crises.

The current global climate crisis, with its associated environmental degradation, resource depletion, and potential for catastrophic events, presents a compelling real-world case study for examining the paper's theoretical framework.¹⁶ Reports from organizations like the United Nations highlight the severity of the situation, indicating that humanity has already transgressed several critical planetary boundaries.²⁰ Deforestation, biodiversity loss, ocean acidification, and various forms of pollution are widespread, while essential resources like fossil fuels, freshwater, and arable land are being rapidly depleted.¹⁶ The concept of "Earth overshoot day," which marks the date when humanity's demand for ecological resources and services exceeds what Earth can regenerate in a year, arriving earlier each year, starkly illustrates this unsustainable trend.¹⁶ The overwhelming scientific consensus supports the view that the climate crisis poses an existential threat to human civilization, with the potential for cascading effects from environmental degradation leading to widespread societal disruption and even collapse.²¹ This planetary-scale crisis, driven by unsustainable human activity, makes the theoretical concepts of "asymptotic burnout" and "homeostatic awakening" not merely academic but profoundly relevant to our immediate future.

2. Deconstructing Asymptotic Burnout: The Path to Collapse?

The paper's analysis hinges on the concept of superlinear scaling observed in urban systems, where various metrics increase more than proportionally with population size, characterized by a scaling exponent β greater than 1.¹ This phenomenon is well-documented for indicators such as productivity and innovation, but critically, it also applies to energy consumption. The paper attributes this scaling to the heightened social interactions and accelerated information exchange that occur in denser urban environments. The fundamental premise of the paper is that a globally interconnected planetary civilization might exhibit similar dynamics, where the benefits of increased interaction and information flow come at an accelerating cost in terms of resource demand.

Under superlinear scaling, systems experience "singularities," which are defined as crises

where population and resource demand, particularly energy, tend towards infinity within a finite timeframe if left unchecked.¹ These singularities are not necessarily technological in nature but rather represent points of systemic instability arising from unsustainable growth patterns. To avert collapse at these critical junctures, the system necessitates "resets," which correspond to innovations or fundamental changes that temporarily alleviate the pressure and postpone the crisis. These resets might involve technological breakthroughs that enhance resource efficiency, the discovery of new energy sources, or significant shifts in societal organization. However, as a system continues to expand under superlinear scaling, the interval between these essential resets diminishes, leading to an increasing frequency of crises. This escalating cadence of instability poses a significant challenge to the system's ability to adapt and maintain equilibrium.

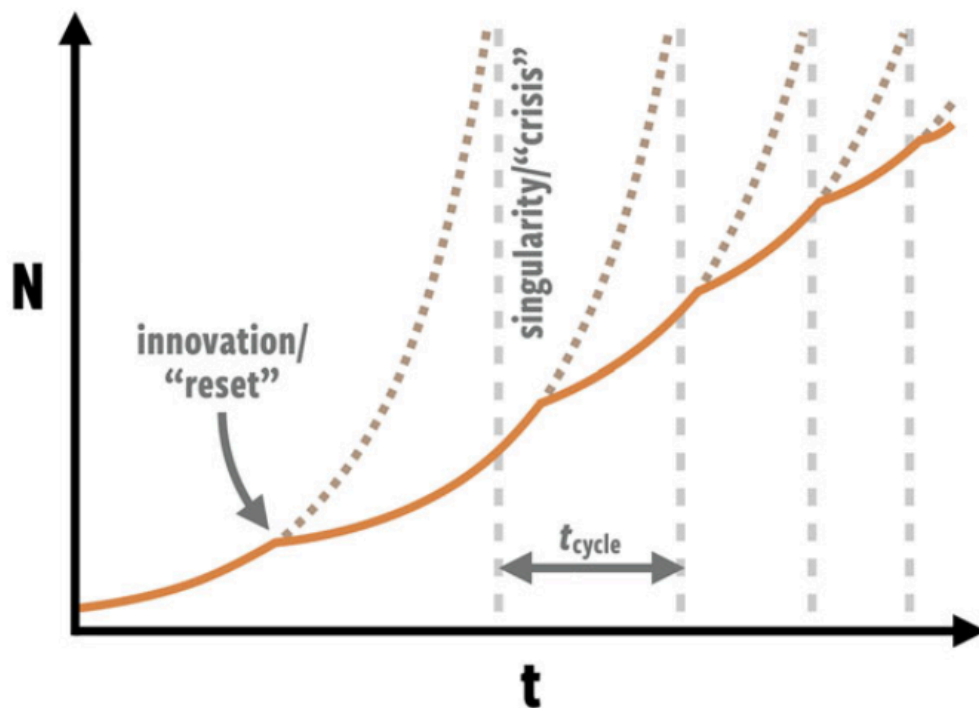


Figure 1. The growth trajectory of a city with scaling coefficient $\beta > 1$ leads to singularities (dashed vertical lines) that must be avoided by innovative resets. The time scale between resets decreases as the population, N , increases. Adapted from Bettencourt *et al.* [10].

"Asymptotic burnout" represents the ultimate crisis point in this trajectory, where the time required to develop and implement the necessary resets or innovations becomes longer than the time scale between the increasingly frequent singularities.¹ At this juncture, the

civilization's capacity to innovate and adapt is overwhelmed by the accelerating pace of crises, placing it on an unsustainable path towards irreversible decline or collapse. Asymptotic burnout, therefore, signifies a potential point of no return for a planetary civilization that fails to fundamentally alter its growth trajectory and its relationship with its resource base.

You can imagine this as being somewhat similar to the 'beep test' in athletics, but for the whole human race, only with each problem -> solution time window growing exponentially shorter until homo sapiens becomes functionally extinct.

3. The Global Climate Crisis: Humanity on a Burnout Trajectory?

The current global climate crisis manifests as a multi-faceted environmental emergency characterized by extensive degradation across various Earth systems. Deforestation, driven by agricultural expansion and resource extraction, is rampant.¹⁶ Biodiversity is being lost at an alarming rate, threatening the delicate balance of ecosystems.¹⁶ The oceans are becoming increasingly acidic due to the absorption of excess carbon dioxide, jeopardizing marine life.²⁴ Pollution, in the form of air contaminants, water contamination, and plastic debris, is pervasive, impacting both human and environmental health.¹⁶ Simultaneously, critical natural resources are facing depletion. Fossil fuel reserves, the primary energy source for much of human activity, are finite.¹⁶ Freshwater scarcity is becoming an increasingly pressing issue in many regions.¹⁷ Arable land is being degraded by unsustainable agricultural practices.¹⁷ The concept of "Earth overshoot day" serves as a stark reminder that humanity's annual demand for ecological resources and services now exceeds the planet's capacity to regenerate them within that year.¹⁶ This comprehensive environmental crisis directly mirrors the conditions that the paper suggests could lead to "asymptotic burnout," indicating that our unsustainable consumption patterns are rapidly eroding the natural capital upon which our civilization depends.

The dominant global economic model continues to prioritize and incentivize continuous economic growth, often measured by Gross Domestic Product (GDP).⁴ This emphasis on ever-increasing production and consumption of goods and services creates an inherent conflict with the finite resources of our planet.¹⁶ The linear "take, make, use, discard" model that underpins much of our economic activity further exacerbates this issue by generating vast amounts of waste and requiring the continuous extraction of virgin materials.²⁷ This relentless pursuit of economic growth, without sufficient regard for environmental limits and resource constraints, embodies the "unyielding growth" that the paper identifies as a key driver of "asymptotic burnout."

The escalating impacts of climate change can be seen as real-world manifestations of the "singularities" described in the paper's framework. We are witnessing an increasing frequency and intensity of extreme weather events, including heatwaves, droughts, floods, wildfires, and storms.¹⁶ Sea-level rise threatens coastal communities, ocean acidification disrupts marine ecosystems, and overall ecological stability is being undermined. These climate-related disasters demand immediate responses, significant financial and logistical resources, and innovative solutions for both adaptation and mitigation. The growing scientific concern that

we may be approaching or even crossing critical "tipping points" in the Earth's climate system²² further underscores the shrinking window of opportunity for effective action, echoing the paper's concern about the timescale of innovation versus the timescale of crises.⁶ The accelerating pace and increasing severity of these events suggest that humanity may indeed be on a trajectory where the rate of crisis generation is outpacing our ability to innovate and adapt.

4. Understanding Homeostatic Awakening: A Shift Towards Sustainability

In contrast to the path of asymptotic burnout, the paper proposes the concept of "homeostatic awakening," which represents a fundamental and conscious shift in a civilization's values, priorities, and goals.¹ This awakening entails moving away from an overriding focus on unyielding economic growth towards a greater emphasis on long-term stability, the well-being of the population, and a sustainable relationship with the environment. This profound transformation is triggered by the civilization's recognition of its unsustainable trajectory and the looming threat of "asymptotic burnout." It signifies a move beyond purely quantitative measures of economic output to encompass qualitative aspects such as environmental health, social equity, and overall quality of life.

In a state of "homeostatic awakening," the primary objective shifts from continuous material expansion, which often drives unsustainable resource consumption, to maintaining a dynamic equilibrium within the planet's ecological boundaries.¹ This might involve a transition to a circular economy, where resources are reused and recycled, a strong emphasis on resource efficiency in all sectors, and potentially a reduction in overall consumption in certain areas.²⁷ Concepts like "degrowth," which advocates for a planned reduction of production and consumption in wealthy nations to achieve ecological sustainability and social justice²⁸, or the adoption of well-being indicators such as Bhutan's Gross National Happiness³ as alternative measures of societal progress, could become more prominent. The transition to homeostasis necessitates a fundamental re-evaluation of societal values and priorities, recognizing that long-term survival and well-being are best achieved through a stable and sustainable relationship with the environment.

Crucially, the paper emphasizes that a "homeostatic awakening" is predicated on the civilization developing the capacity for collective self-awareness and critical thinking, enabling it to understand its own unsustainable trajectory and the potential for "asymptotic burnout".¹ This requires robust scientific understanding of complex environmental and social systems, effective communication of risks to the public and policymakers, and a societal willingness to confront uncomfortable truths and embrace necessary changes. The importance of data collection, sophisticated modeling, and interdisciplinary research in accurately assessing our current path and projecting future scenarios cannot be overstated. The ability for a civilization to achieve this awakening hinges on its capacity for collective learning and a political and social system that can translate scientific understanding into meaningful action.

5. Mitigating Climate Change: Glimmers of a Homeostatic Awakening?

The rapidly growing development, deployment, and decreasing costs of renewable energy technologies such as solar photovoltaic, wind power, and geothermal energy represent a significant global effort to decarbonize the energy system and mitigate climate change.⁸ This transition marks a fundamental shift away from reliance on finite and polluting fossil fuels towards more sustainable and abundant energy sources. This move towards cleaner energy can be interpreted as an early, albeit crucial, step towards the "homeostatic awakening" described in the paper, demonstrating a growing recognition of the unsustainability of our current energy paradigm and a conscious effort to adopt alternatives with lower environmental impact.

Across various sectors of human activity, there is an increasing adoption of sustainable practices. Sustainable agriculture, focusing on reducing emissions and environmental impact through methods like plant-based diets, reduced food waste, and regenerative farming, is gaining traction.¹⁶ Sustainable industry is emphasizing resource efficiency and minimizing pollution through circular economy principles and green technologies.¹⁸ Sustainable consumption patterns, aimed at reducing overconsumption and waste by using reusable products and embracing more minimalist lifestyles, are becoming more prevalent.¹⁶ This broadening adoption of sustainable practices signals a growing societal awareness of the interconnectedness between human actions and environmental consequences, suggesting a move towards a more holistic understanding of sustainability that aligns with the principles of "homeostatic awakening."

International agreements and frameworks, such as the Paris Agreement, play a crucial role in establishing global goals and fostering cooperation among nations to reduce greenhouse gas emissions and address climate change. While the challenges of achieving effective global agreements are significant, these efforts represent a collective, albeit imperfect, attempt to address a planetary crisis. Despite the difficulties in achieving consensus and implementing effective policies at the international level, these frameworks signify a growing recognition among nations of the shared threat posed by climate change and a commitment, however tentative, to collective action, which is a crucial step towards a global "homeostatic awakening."

6. Parallels Between the Paper's Framework and Humanity's Future:

The theoretical framework presented in the paper, outlining the potential for "asymptotic burnout" followed by either collapse or "homeostatic awakening," offers a valuable high-level perspective for understanding the long-term implications of the climate crisis.¹ Historical examples of societal collapses have been linked by some researchers to adverse environmental changes¹⁰, although a truly global collapse of human civilization would be unprecedented.²¹ By framing the climate crisis as a potential path towards "asymptotic burnout" if left unaddressed, the paper underscores the urgency of fundamental change. Conversely, the concept of "homeostatic awakening" provides a theoretical pathway towards a more sustainable future, suggesting that conscious choices and a shift in priorities can alter our trajectory.

The "dataome," the interconnected global information network, (more commonly known as the internet), plays an ambivalent role in the context of climate change and the potential for both "burnout" and "awakening".³ On one hand, it can facilitate rapid and widespread consumption, potentially accelerating unsustainable trends. On the other hand, it enables unprecedented levels of information sharing, scientific collaboration, and the mobilization of collective action necessary for a "homeostatic awakening." The ultimate impact of the dataome on our future will likely depend on our ability to harness its potential for fostering understanding and driving collective action towards a more sustainable path.

7. Burnout or Awakening: Humanity's Choice?

The paper's analysis suggests that if current trends of unsustainable growth and resource consumption persist, the global climate crisis could indeed lead to an "asymptotic burnout" scenario for humanity.¹ The potential for exceeding critical "tipping points" in the Earth's climate system²² raises concerns about irreversible and catastrophic changes that might occur regardless of future technological innovation. The concept of the "Great Filter"⁶ within the Fermi paradox further supports the idea that self-destruction through unsustainable practices is a plausible fate for advanced civilizations.

However, the paper also offers a more hopeful possibility: "homeostatic awakening".¹ Whether this becomes a reality for humanity depends on several critical factors, including the speed and scale of our transition to a sustainable economy, the continued development and deployment of innovative green technologies, and a fundamental transformation in societal values and consumption patterns. The paper notes historical "mini-awakenings," such as the banning of CFCs³, and the increasing global awareness of the climate crisis as potential indicators of a nascent shift in consciousness. The growing social and political movements advocating for climate action also offer encouraging signs that a "homeostatic awakening" may be underway, although the pace and scale of change need to be significantly accelerated to effectively address the risks of "asymptotic burnout."

8. Environmental Sustainability and Long-Term Survival: Insights from the Paper

The paper's framework, while rooted in the context of the Fermi paradox, implicitly underscores the fundamental reality of a finite planet with limited resources. The concept of "asymptotic burnout" arises directly from the notion that unchecked growth in resource consumption will inevitably lead to a crisis.¹ This aligns with the established scientific framework of planetary boundaries, which define the safe operating space for humanity on Earth.²⁰ Transgressing these boundaries increases the risk of triggering large-scale, abrupt, or irreversible environmental changes.²⁵

"Asymptotic burnout" can be interpreted not only as a failure of innovation or societal organization but also as a potential outcome of ecological collapse driven by unsustainable resource exploitation and environmental degradation.¹⁶ The paper's "burnout" scenario serves as a stark warning about the deep and inseparable link between the health of the environment and the long-term viability of human civilization. The increasing frequency and severity of crises preceding burnout highlight the dangers of continued degradation of Earth's

ecosystems, which provide essential resources and stability.

Conversely, "homeostatic awakening," with its central focus on long-term stability and well-being, inherently necessitates a fundamental shift towards environmental stewardship and responsible resource management.¹ Achieving homeostasis requires a civilization to live within its ecological means, conserve resources, and minimize its environmental footprint, demonstrating that true long-term survival is inextricably linked to environmental sustainability.

9. Conclusion: Lessons Learned and the Path Forward

The analysis reveals significant connections between the theoretical concepts of "asymptotic burnout" and "homeostatic awakening" and the real-world challenges posed by the global climate crisis. The paper's framework underscores the universal risks associated with unchecked growth in resource consumption and the potential for an accelerating frequency of crises to overwhelm a civilization's capacity to adapt. It highlights the critical necessity for a conscious and fundamental shift towards sustainability for the long-term survival of any advanced civilization, including our own.

The insights gleaned from the paper serve as a powerful warning for humanity. The current trajectory of environmental degradation and unsustainable resource use carries a significant risk of leading to a scenario akin to "asymptotic burnout," where the accelerating pace of climate-related crises outstrips our ability to innovate and implement effective solutions. However, the concept of "homeostatic awakening" offers a viable alternative, suggesting that a conscious and collective decision to prioritize long-term stability, well-being, and environmental sustainability can alter our path.

Ultimately, the choice between "asymptotic burnout" and "homeostatic awakening" rests with humanity. The urgency of the climate crisis demands immediate and decisive action to transition towards a sustainable future. This requires not only the continued development and deployment of green technologies and the implementation of effective policies but also a fundamental transformation in societal values and consumption patterns. A rapid and comprehensive shift towards environmental stewardship and responsible resource management is essential to avert the potentially catastrophic consequences of unchecked environmental degradation and to chart a course towards a thriving and resilient future for all.



Works cited

1. Asymptotic burnout and homeostatic awakening: a possible solution ..., accessed on April 4, 2025, <https://authors.library.caltech.edu/records/jvgd6-7t589>
2. Asymptotic burnout and homeostatic awakening: a possible solution to the Fermi paradox? | Journal of The Royal Society Interface, accessed on April 4, 2025, <https://royalsocietypublishing.org/doi/abs/10.1098/rsif.2022.0029>
3. On the Trajectories of Planetary Civilizations: Asymptotic Burnout vs. Homeostatic Awakening - MIT Press Direct, accessed on April 4, 2025, https://direct.mit.edu/isal/proceedings-pdf/isal2022/34/8/2035361/isal_a_00485.pdf
4. (PDF) Asymptotic burnout and homeostatic awakening: A possible solution to the Fermi paradox? - ResearchGate, accessed on April 4, 2025, https://www.researchgate.net/publication/360357138_Asymptotic_burnout_and_homeostatic_awakening_a_possible_solution_to_the_Fermi_paradox
5. Asymptotic burnout and homeostatic awakening: a possible solution to the Fermi paradox? - PubMed, accessed on April 4, 2025, <https://pubmed.ncbi.nlm.nih.gov/35506212/>
6. Maybe We Don't Hear From Aliens Because They Choose To Go Silent - Universe Today, accessed on April 4, 2025, <https://www.universetoday.com/articles/maybe-we-dont-hear-from-aliens-because-they-choose-to-go-silent>
7. authors.library.caltech.edu, accessed on April 4, 2025, <https://authors.library.caltech.edu/records/jvgd6-7t589#:~:text=With%20this%20perspective%2C%20we%20hypothesize,the%20time%20scale%20of%20innovation.>
8. Asymptotic burnout and homeostatic awakening: a possible solution to the Fermi paradox? | Journal of The Royal Society Interface, accessed on April 4, 2025, <https://royalsocietypublishing.org/doi/10.1098/rsif.2022.0029>
9. On the Trajectories of Planetary Civilizations: Asymptotic Burnout vs. Homeostatic Awakening - MIT Press Direct, accessed on April 4, 2025, https://direct.mit.edu/isal/article/doi/10.1162/isal_a_00485/112266/On-the-Trajectories-of-Planetary-Civilizations
10. Why the Fermi paradox may not be well explained by Wong and Bartlett's theory of civilization collapse. A Comment on: 'Asymptotic burnout and homeostatic awakening' - Journals, accessed on April 4, 2025, <https://royalsocietypublishing.org/doi/10.1098/rsif.2024.0140>
11. The civilization survival scale: A biological argument for space settlement, accessed on April 4, 2025, <https://www.thespacereview.com/article/4917/1>
12. Fermi paradox - Wikipedia, accessed on April 4, 2025, https://en.wikipedia.org/wiki/Fermi_paradox
13. The Great Filter and the Fermi Paradox | Psychology Today, accessed on April 4, 2025,

- <https://www.psychologytoday.com/us/blog/pop-culture-mental-health/202412/the-great-filter-and-the-fermi-paradox>
14. The Dark Forest Theory: A Chilling Solution to Fermi's Paradox - Medium, accessed on April 4, 2025, <https://medium.com/@ChemAndCode/the-dark-forest-theory-a-chilling-solution-to-fermis-paradox-c576fc0a7307>
 15. Great Filter - Wikipedia, accessed on April 4, 2025, https://en.wikipedia.org/wiki/Great_Filter
 16. How Overconsumption Affects the Environment and Health, Explained - Sentient Media, accessed on April 4, 2025, <https://sentientmedia.org/overconsumption/>
 17. Global Resources Dwindling as Demand Rises - Population Matters, accessed on April 4, 2025, <https://populationmatters.org/news/2024/03/global-resources-dwindling-as-demand-rises/>
 18. Natural-Resource Use and Environmental Impacts | One Planet network, accessed on April 4, 2025, <https://www.oneplanetnetwork.org/SDG-12/natural-resource-use-environmental-impacts>
 19. Global sustainable resource consumption needed urgently, UN report says | World Economic Forum, accessed on April 4, 2025, <https://www.weforum.org/stories/2024/03/sustainable-resource-consumption-urgent-un/>
 20. en.wikipedia.org, accessed on April 4, 2025, https://en.wikipedia.org/wiki/Climate_change_and_civilizational_collapse#:~:text=n%202022%2C%20the%20United%20Nations.boundaries%20in%20the%20SDG%20targets.
 21. Climate change and civilizational collapse - Wikipedia, accessed on April 4, 2025, https://en.wikipedia.org/wiki/Climate_change_and_civilizational_collapse
 22. Our civilization's survival depends on collective action | World Economic Forum, accessed on April 4, 2025, <https://www.weforum.org/stories/2024/12/civilization-survival-depends-on-collective-action/>
 23. UN Warns of 'Total Societal Collapse' Due to Breaching of Planetary Boundaries, accessed on April 4, 2025, <https://bylinetimes.com/2022/05/26/un-warns-of-total-societal-collapse-due-to-breaching-of-planetary-boundaries/>
 24. The nine boundaries humanity must respect to keep the planet habitable - Mongabay, accessed on April 4, 2025, <https://news.mongabay.com/2021/03/the-nine-boundaries-humanity-must-respect-to-keep-the-planet-habitable/>
 25. Planetary boundaries - Stockholm Resilience Centre, accessed on April 4, 2025, <https://www.stockholmresilience.org/research/planetary-boundaries.html>
 26. An Economic Perspective on the Search for Extraterrestrial Intelligence | by Wim Naudé, accessed on April 4, 2025, <https://medium.com/@wimnaude/an-economic-perspective-on-the-search-for->

[extraterrestrial-intelligence-Of48032f2d16](#)

27. Sustainable Consumption and Production | One Planet network, accessed on April 4, 2025,
<https://www.oneplanetnetwork.org/SDG-12/sustainable-consumption-and-production>
28. What long-term degrowth would actually entail. Or, Fermi Paradox: Asymptotic burnout and homeostatic awakening : r/IsaacArthur - Reddit, accessed on April 4, 2025,
https://www.reddit.com/r/IsaacArthur/comments/18w8clr/what_longterm_degrowth_would_actually_entail_or/
29. Environmental, social and governance disclosure associated with the firm value. Evidence from energy industry - ResearchGate, accessed on April 4, 2025,
https://www.researchgate.net/publication/355360279_Environmental_social_and_governance_disclosure_associated_with_the_firm_value_Evidence_from_energy_industry
30. Why the Fermi paradox may not be well explained by Wong and Bartlett's theory of civilization collapse. A Comment on: 'Asymptotic burnout and homeostatic awakening, accessed on April 4, 2025,
<https://pmc.ncbi.nlm.nih.gov/articles/PMC11523100/>