Our Commitment to Impermanence

Author's Note: The following section provides an overview of my case for the complete and permanent collapse of human industrialism by the year 2050. The remainder of the book, Industrialism - Our Commitment to Impermanence, provides supporting details and evidence.

> **The point of this talk is simply that reliance on non-renewable natural resources (NNRs), which enabled us to do more things than we did before we began that reliance, has made us vulnerable. *Such reliance is a commitment to impermanence*. (Catton)**

For approximately three million years, our hunter-gatherer ancestors subsisted on renewable natural resources (RNRs) – water, soil, and naturally-occurring plants and animals; their hunter-gatherer way of life was sustainable.

During the next 12 thousand years, our agrarian ancestors added human-modified renewable Earth resources (ERs) – domesticated and cultivated plants and animals – to the mix; their agrarian way of life was "quasi-sustainable".

During the past 250 years, our industrial existence has been enabled by our ever-increasing utilization of finite and non-replenishing nonrenewable natural resources (NNRs) – fossil fuels, metals, and nonmetallic minerals. Our industrialized way of life is terminally unsustainable – it is inevitably and irreversibly self-eradicating.

A Question of Perspective

> We must now see that people are indeed different from other creatures, but not *all together* different. Our cultural type of inheritance is tremendously significant; it evolves in response to differently operating selection pressures than those that change genotypic distributions. It was, however, a gross exaggeration to suppose that culture exempted us from the principles of ecology. (Catton)

To properly understand human industrialism and its evolution, human existence must be viewed from the Nature-centered ecological perspective, rather than from the human-centered anthropocentric perspective.

The Anthropocentric Perspective

Almost without exception, people who are alive today view reality from the anthropocentric perspective, which perceives and interprets human existence in terms of human cultural circumstances – i.e., prevailing political, economic, and societal conditions.

Viewed from the anthropocentric perspective, our industrial existence occurs within the context of our cultural environment:

- **Human ingenuity** – human resourcefulness, technological innovations, efficiency improvements, and productivity enhancements – enables…
- **Human prosperity** – human economic output and material living standards – which governs…
- **Human cultural** – political, economic, and societal – **circumstances**.

Figure P-1: Humanity's Operating Environment
(Anthropocentric Perspective)

Accordingly, our previously inconceivable industrial prosperity and cultural circumstances are products of our unparalleled ingenuity. So long as we continue to apply human ingenuity toward improving human prosperity, industrialism will flourish.

The critical limitation associated with the anthropocentric perspective is its failure to consider the fundamental role played by our natural environment in enabling and governing human existence.

The Ecological Perspective

Viewed from the ecological perspective, humankind numbers among the billions of biotic (living) and abiotic (nonliving) entities that interact and evolve through various biological, geological, chemical, and physical processes and phenomena, and that, in combination, comprise and govern existence on Earth.

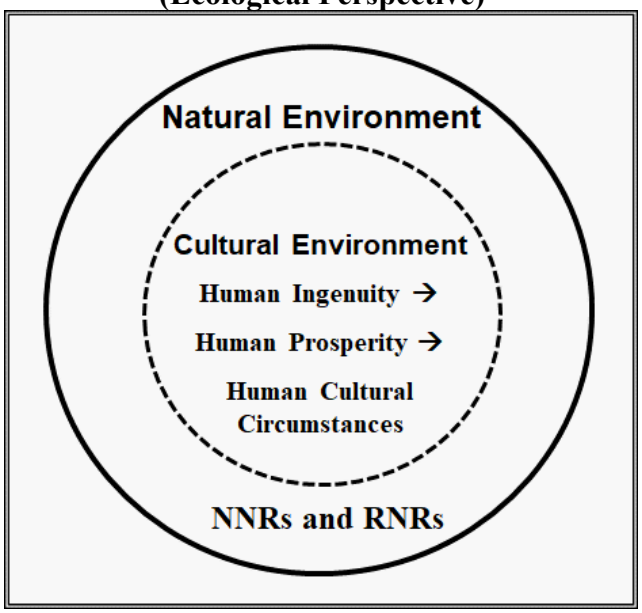
From the ecological perspective, industrial human existence occurs within the context of our natural environment – the broader ecological context within which our cultural environment exists.

Accordingly, the primary enablers of our industrialized way of life – and of all life on Earth – are Earth resources:

- **Renewable Natural Resources (RNRs)** – water, soil, and naturally-occurring biota (plant and animal life), and
- **Nonrenewable Natural Resources (NNRs)** – fossil fuels, metals, and nonmetallic minerals.

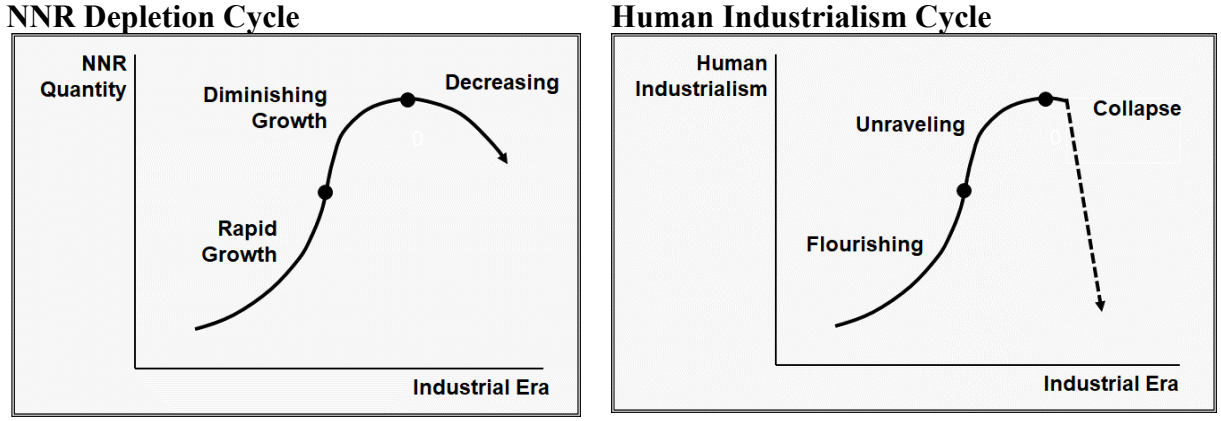
From the ecological perspective, our previously inconceivable industrial prosperity and cultural circumstances are enabled by our persistent and increasing depletion of Earth's finite and non-replenishing NNR reserves. All infrastructure, machines, products, energy, and services that define and perpetuate our industrial existence are NNR-based or NNR-derived.

Figure P-2: Humanity's Operating Environment
(Ecological Perspective)



And because the NNR depletion function follows a single-pulse – one-up and one-down – cycle, our NNR-enabled industrial era will follow a single-pulse cycle as well.

Figure P-3: Industrial Era Cyclicality



Industrialism, therefore, is a self-terminating human subsistence strategy in which finite and non-replenishing fossil fuels, metals, and nonmetallic minerals are converted into the infrastructure, machines, products, energy, and services that afford humanity's extraordinary – but temporary – industrialized way of life.

The Paradox of Human Industrialism

> All life needs and uses natural resources. Man alone has changed natural distributions and productivities, and by doing so systematically, has shaped the form of controlled living we call civilization. He has managed to combat climatic extremes and to increase vastly the Earth's yield of palatable foods above Nature's random growth. As a consequence, he has expanded his occupation of the globe to its farthest reaches and proliferated *Homo sapiens* far beyond the numbers that were once in stable balance with an unmanipulated Nature. (Skinner)

The Human Epoch

As we have become increasingly ingenious during our 3-million-year human epoch, we have become increasingly over-exploitive of Earth resources, and have thereby become increasingly prosperous – and "less sustainable".

Table P-1: The Human Epoch

Human Attributes	Hunter-Gatherer	Agrarian	Industrial
Human Ingenuity	Limited	Increasing	Extraordinary
Earth Resource Mix	Naturally-occurring and naturally-replenishing RNRs	Human-modified and human-managed ERs	Finite and non-replenishing NNRs
Human/Earth Interaction	Passive inhabitants	Deliberate Earth resource managers	Chronic Earth resource overexploiters
Human Population	Few million	Hundreds of millions	Several billion
Human Prosperity	Subsistence level for all	Subsistence level for the vast majority	Far beyond subsistence level for most
Human/Earth Relationship	Sustainable	Quasi-sustainable	Terminally unsustainable

Hunter-Gatherer Era Given their relatively limited ingenuity, our hunter-gatherer (HG) ancestors subsisted, like all other Earth species, exclusively on naturally-occurring, naturally-replenishing RNRs – water, soil, and naturally-occurring plants and animals.

And while this Earth resource utilization behavior afforded only subsistence-level existence for human HG populations, the HG way of life was sustainable – i.e., it would have persisted indefinitely in the absence of one or more terminally disruptive changes.

Agrarian Era Our increasingly ingenious agrarian ancestors deliberately modified naturally-occurring plant and animal species and habitats – primarily through domestication, selective breeding, cultivation, fertilization, irrigation, and weed and pest control – and thereby improved human prosperity. This Earth resource utilization behavior produced greatly expanded subsistence level agrarian populations, while simultaneously producing prosperity beyond subsistence level for small groups of elites.

Because it was enabled for the most part by human-modified – not naturally-occurring – Earth resources, pre-industrial agrarianism was "quasi-sustainable". That is, absent continuous management of human-modified species and habitats, humanity's pre-industrial agrarian way of life would have collapsed.

Industrial Era We extraordinarily ingenious industrial *Homo sapiens* are unique among Earth species, past and present, because our existence is enabled by finite and non-replenishing NNRs. And while this Earth resource utilization behavior has afforded previously inconceivable prosperity for billions of human beings, both human industrialism and the Earth resource utilization behavior by which it is enabled are terminally unsustainable.

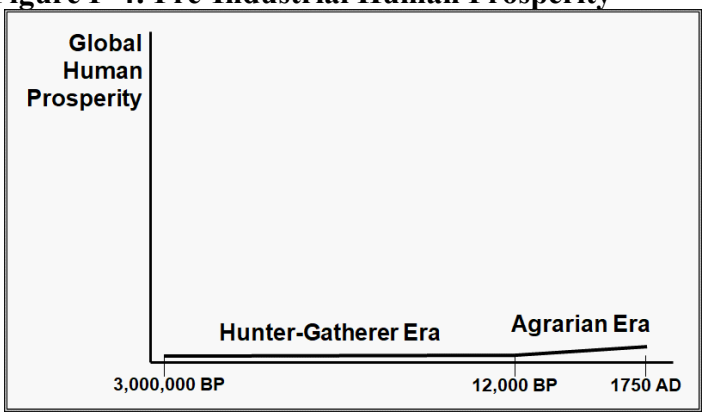
That is, persistent NNR reserve depletion – especially depletion on an industrial scale – will inevitably render globally available, economically viable NNR supplies insufficient to perpetuate our industrial existence.

Human Prosperity Improvement

In stark contrast to the almost nonexistent prosperity improvement achieved during our HG era, and the negligible prosperity improvement achieved during our agrarian era, prosperity improvement during our NNR-enabled industrial era has been nothing short of spectacular.

Pre-Industrial Human Prosperity

Figure P-4: Pre-Industrial Human Prosperity



Pre-industrial hunter-gatherer and agrarian subsistence strategies, which were enabled by naturally-occurring Earth resources (HG) and human-modified Earth resources (agrarian), afforded only subsistence level existence for most of humankind.

Humanity's hunter-gatherer era spanned approximately three million years – over 120,000 human generations – from 3,000,000 BP (before present) to 12,000 BP.

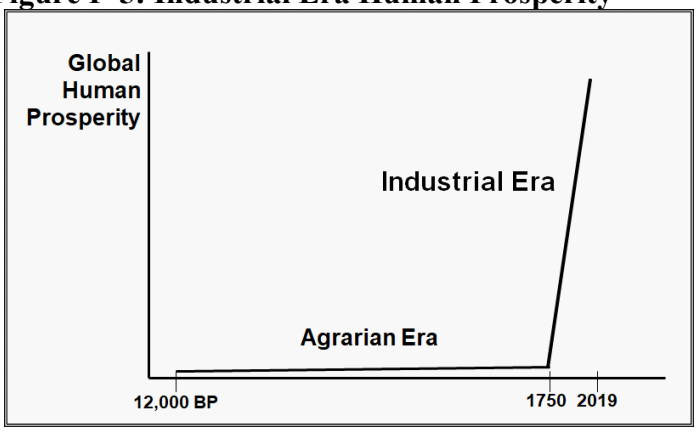
During this period, the global human population probably never exceeded 5 million; annual global economic output, as defined by global gross domestic product (GDP), likely never exceeded $500 million; and the average HG era human material living standard, as proxied by global per capita GDP, remained below $100 per annum.

Humanity's pre-industrial agrarian era spanned approximately 12,000 years – over 500 human generations – from 12,000 BP to 1750 AD.

By 1750, the global human population had reached approximately 720 million; annual global economic output, as defined by global gross domestic product (GDP), approximated $129 billion; and the average human material living standard, as proxied by global per capita GDP, had yet to reach $200 per annum.

Industrial Era Human Prosperity

Figure P-5: Industrial Era Human Prosperity



It was not until 18th century Great Britain established a cultural environment that encouraged British industrialists to fully exploit their extraordinarily favorable natural environment – i.e., to utilize NNRs on an industrial scale – that human prosperity improved significantly, and then meteorically.

Humanity's industrial era has spanned less than 300 years to date – approximately 10 human generations – from 1750 to present (2019). During this relatively brief period:

- The global human population has increased by a factor of ten – from approximately 720 million to 7.7 billion;

- Annual global economic output, as defined by global gross domestic product (GDP), has increased by an astounding 393 times – from $129 billion to $50,685 billion; and
- The average human material living standard, as proxied by global per capita GDP, has increased by an extraordinary 37 times – from $178 per annum to $6,606 per annum.

The Enablers of Industrial Era Human Prosperity Our extraordinary industrial era prosperity has been enabled by our extraordinary NNR utilization during the period.

Table P-2: Industrial Era Global NNR Extraction/Production Quantities 1750 and 2019

NNR	Metric Tonnes		Increase (Xs)
	1750	2019	1750-2019
Coal	7,000,000	7,921,000,000	**1,132**
Copper	10,000	20,400,000	**2,040**
Iron Ore	260,000	2,450,000,000	**9,423**
Lead	15,000	4,720,000	**315**
Zinc	5,000	12,700,000	**2,540**
Tin	4,500	296,000	**66**
Cement	165,000	4,100,000,000	**24,848**
Salt	220,000	283,000,000	**1,286**
Sulfur	27,500	80,000,000	**2,909**

Between 1750 and 2019, the annual global extraction and production quantities associated with these indispensable NNRs increased spectacularly – coal and salt by over 1,000 times, copper, zinc, and sulfur by over 2,000 times, iron ore by over 9,000 times, and cement by nearly 25,000 times!

Sources: USGS, US EIA, and other.

The sheer magnitude of human NNR extraction/production during 2019 was extraordinary as well.

Nearly 2.5 billion metric tonnes of newly mined iron ore, over 4 billion metric tonnes of newly produced cement, and nearly 8 billion metric tonnes of newly mined coal – over 2,000 pounds of coal for every man, woman, and child on planet Earth!

Notably, these extraordinary increases in global NNR extraction/production occurred despite ever-increasing NNR recycling, reuse, conservation, and substitution, and despite an ever-expanding array of productivity-increasing innovations and efficiency improvements intended to minimize our NNR utilization.

The indisputable fact remains,

> Strong [NNR] demand growth comes mainly from millions of aspiring individuals in emerging economies striving for a better material standard of living. Even with dramatic increases in recycling, an overall increase in newly mined materials is required to support the emergence of individuals, communities and countries from stagnation and poverty. (ICMM)

Our NNR requirements will therefore increase unabated in the future, as nearly 2 billion industrialized humans attempt to remain industrialized, 4+ billion industrializing humans attempt to completely industrialize, and 2+ billion pre-industrial humans attempt to industrialize.

According a 2016 UN analysis,

> Assuming that the world will implement similar systems of production and systems of provision for major services – housing, mobility, food, energy and water supply – nine billion people will require 180 billion tonnes of materials by 2050, almost three times today's [2010] amounts.

The Consequences of Industrial Era Human Prosperity No other species on Earth, past or present, has managed to live beyond subsistence level, much less to achieve the extraordinary prosperity enjoyed by industrial humanity, because no other species has possessed the ingenuity required to exploit NNRs on an industrial scale.

Only since the advent of industrialism have enormous real wealth surpluses been created by applying human ingenuity to fossil fuels, metals, and nonmetallic minerals. Consequently, only during our industrial era have billions of people been able to live, rather than simply exist.

Paradoxically, however, because industrial human prosperity, and human industrialism more broadly, are enabled by finite and non-replenishing NNRs, we uniquely ingenious industrial *Homo sapiens* have been irreversibly undermining our existence for the past 250 years.

The Demise of Human Industrialism

As one of the millions of species that inhabit planet Earth, *Homo sapiens* is subject to the same ecological laws of Nature that govern all other species. With respect to our industrial existence and to the Earth resource utilization behavior by which it is enabled, one natural law is paramount: **"Net Depletion" of Earth Resource Reserves is Unsustainable**.

That is, the rate at which an Earth resource reserve is depleted must not exceed the rate at which the reserve is replenished. Persistent "net depletion" will inevitably render the Earth resource reserve insufficient to support dependent species populations.

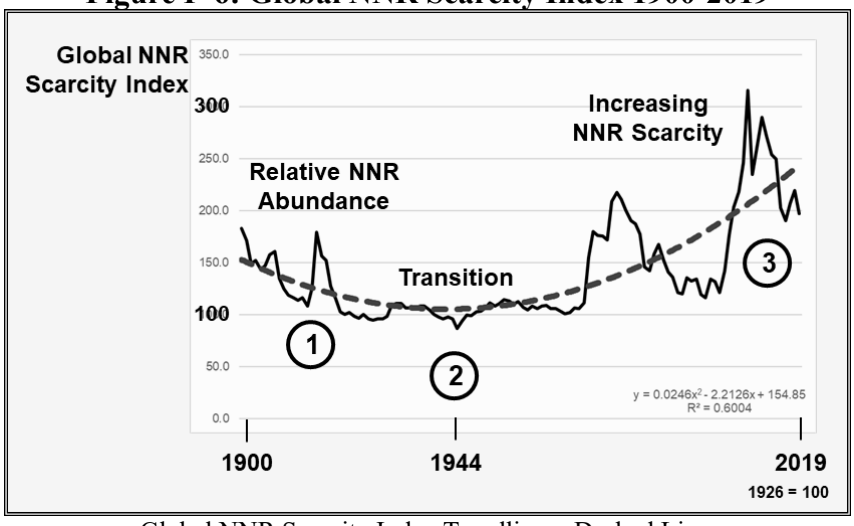
Given that all NNR depletion constitutes "net depletion", persistent human NNR depletion – especially depletion on an industrial scale – will inevitably render Earth's NNR reserves insufficient to support our NNR-dependent species. Unfortunately for humankind, "inevitably" is "now".

Trend Reversals

During the mid-20th century, the fundamental trends that govern the evolution of our industrial era – relative global NNR scarcity and global human prosperity improvement – transitioned permanently from favorable to unfavorable.

Global NNR Scarcity As illustrated by the Global NNR Scarcity Index – an indicator of aggregate relative global NNR scarcity between 1900 and 2019 – the secular (long term) global NNR scarcity trend transitioned permanently during the mid-20th century from "relative NNR abundance" to "increasing NNR scarcity".

Figure P-6: Global NNR Scarcity Index 1900-2019



Global NNR Scarcity Index Trendline = Dashed Line.
Composite NNR Price Curve = Solid Line.
Sources: USGS, BP Statistical Review, US EIA, and other.

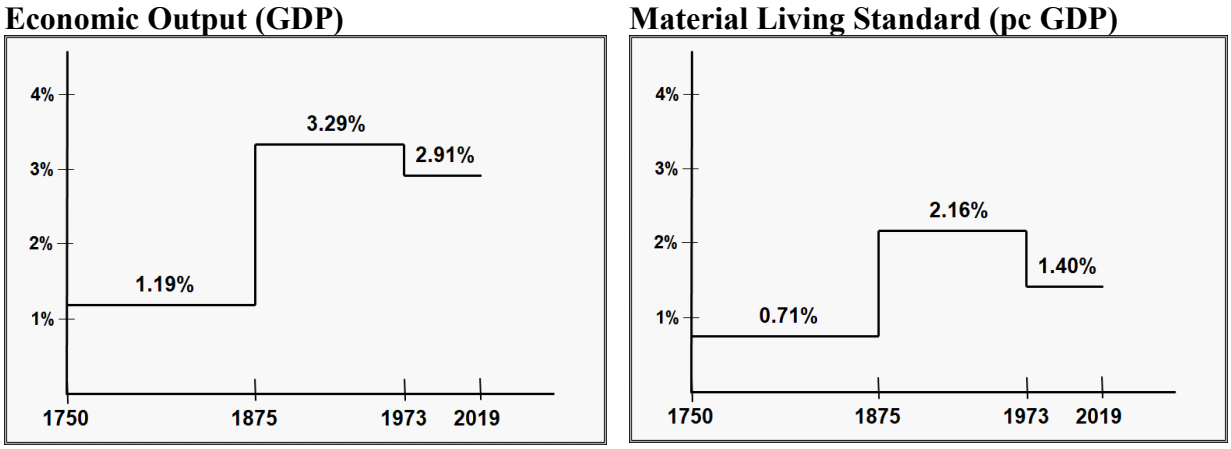
1 Between 1900 and 1944, the Global NNR Scarcity Index (dashed line) decreased by 33%, from 152 to 102, indicating relative global NNR abundance during the 44-year period.

2 In 1944, the Global NNR Scarcity Index reached its minimum of 102, indicating a permanent transition from relative global NNR abundance to increasing global NNR scarcity.

3 Between 1944 and 2019, the Global NNR Scarcity Index increased by an extraordinary 150%, from 102 to 248, indicating increasingly pervasive global NNR scarcity during the most recent 75-year period.

Global Human Prosperity The transition from relative global NNR abundance to increasingly pervasive global NNR scarcity during the mid-20th century caused a simultaneous, permanent transition from rapidly improving global human prosperity to faltering global human prosperity.

Figure P-7: Industrial Era Global Human Prosperity Improvement



Sources: Delong, World Bank, and Macrotrends.

- Between 1750 and 1875, global human prosperity improved rapidly by pre-industrial standards. Global GDP (economic output) increased by 1.19% compounded annually, while global pc GDP (the average material living standard) increased by 0.71% compounded annually.
- Between 1875 and 1973, global human prosperity improved extraordinarily – despite WW1, the 1918-1919 global flu pandemic, the Great Depression, and WW2. Global GDP (economic output) increased by an unprecedented 3.29% compounded annually, while global pc GDP (the average material living standard) increased by an equally unprecedented 2.16% compounded annually.
- Between 1973 and 2019, global human prosperity faltered – despite the remarkable industrialization initiatives launched by China and other Eastern nations. The increase in global GDP (economic output) diminished considerably to 2.91% compounded annually, while the increase in global pc GDP (the average material living standard) slowed to an anemic 1.40% compounded annually.

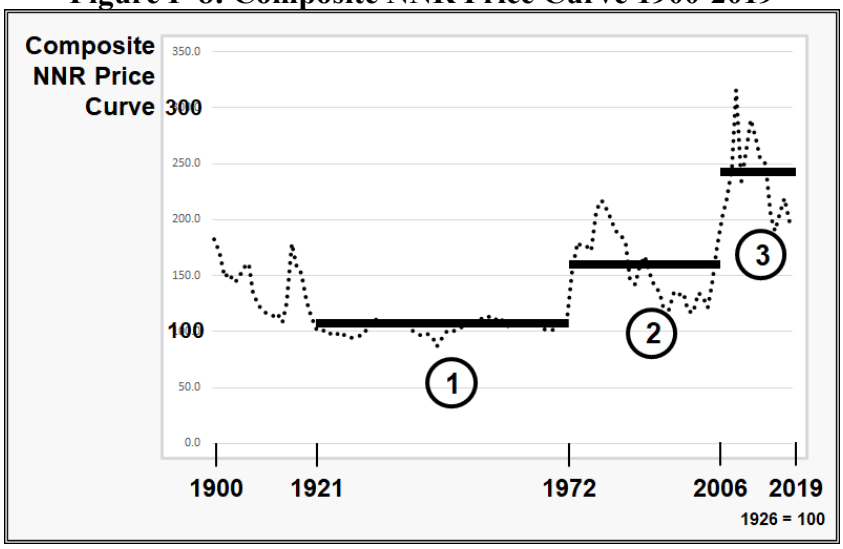
In the process of applying our unparalleled ingenuity toward achieving previously inconceivable prosperity, we extracted Earth's high quality, low cost, and low priced NNRs. What remains are Earth's low quality, high cost, and high priced NNRs – which can enable only faltering global human prosperity.

Trend Acceleration

The unfavorable trends that emerged during the mid/late 20th century – increasingly pervasive global NNR scarcity and faltering global human prosperity – accelerated during the first two decades of the 21st century.

Accelerating Global NNR Scarcity NNR prices increased to historically unprecedented levels during the first two decades of the new millennium, indicating accelerating global NNR scarcity during the period.

Figure P-8: Composite NNR Price Curve 1900-2019



Sources: USGS, BP Statistical Review, US EIA, and other.

1 During the latter years of our Old Normal, between 1921 and 1972, which were characterized by relative global NNR abundance (Nature's Stimulus), the Composite NNR Price Curve averaged a historically low 103.

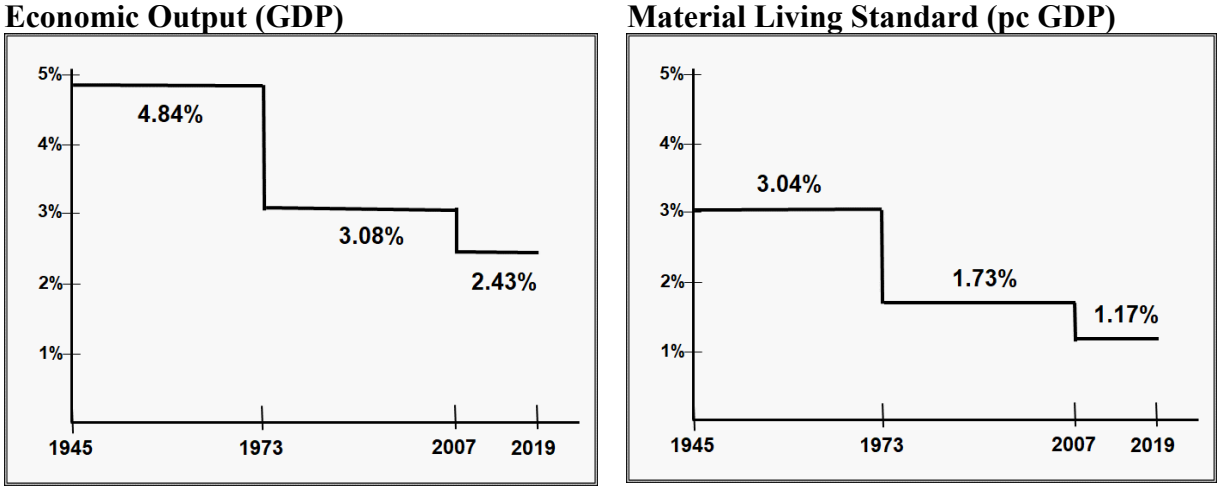
2 During the pre-Great Recession years of our New Normal, between 1973 and 2006, which were characterized by increasingly pervasive global NNR scarcity (Nature's Squeeze), the Composite NNR Price Curve averaged 159, which exceeded by 54% the historically low level of 103 that existed between 1921 and 1972.

3 From the Great Recession forward, between 2007 and 2019, which was characterized by accelerating global NNR scarcity (Nature's Squeeze tightened), the Composite NNR Price Curve averaged 242, which exceeded by 52% the 159 level that existed between 1973 and 2006 – and exceeded by 135% the historically low level of 103 that existed between 1921 and 1972.

By the dawn of the 21st century, most NNR deposits that had been discovered during our industrial era were extensively depleted, and major previously untapped global NNR frontiers no longer existed. Accelerating global NNR scarcity – as indicated by inordinately high and rapidly increasing NNR price levels – was the inescapable consequence.

Rapidly Faltering Global Human Prosperity Accelerating global NNR scarcity constrained human prosperity improvement during the first two decades of the new millennium, to rates that were substantially lower than those that were achieved prior to the Great Recession, and significantly lower than those that were achieved during the mid-20th century.

Figure P-9: Global Human Prosperity Improvement 1945-2019



Sources: Delong, World Bank, and Macrotrends.

- During the post-WW2 rebuilding period and the culmination of our Old Normal, between 1945 and 1973, global GDP (economic output) increased at an unprecedented 4.84% compounded annually, while the global pc GDP (the average material living standard) increased at an equally unprecedented 3.04% compounded annually.
- During the pre-Great Recession years of our New Normal, between 1973 and 2007, the compound annual growth rate in global GDP (economic output) decreased substantially, from 4.84% to 3.08%, while the compound annual growth rate in pc GDP (the average material living standard) decreased substantially as well, from 3.04% to 1.73%.
- During the Great Recession and post-recession "non-recovery", between 2007 and 2019, the compound annual growth rate in global GDP (economic output) further decreased from 3.08% to a lackluster 2.43%, while the compound annual growth rate in global pc GDP (the average material living standard) further decreased from 1.73% to a meager 1.17% – despite historically unprecedented global fiscal and monetary "stimulus" employed during the period.

The notion that global human prosperity will ever again improve at rates comparable to those that were achieved during the mid-20th century is geologically impossible. The high quality/low cost NNRs that enabled such prosperity improvement have long since been extracted.

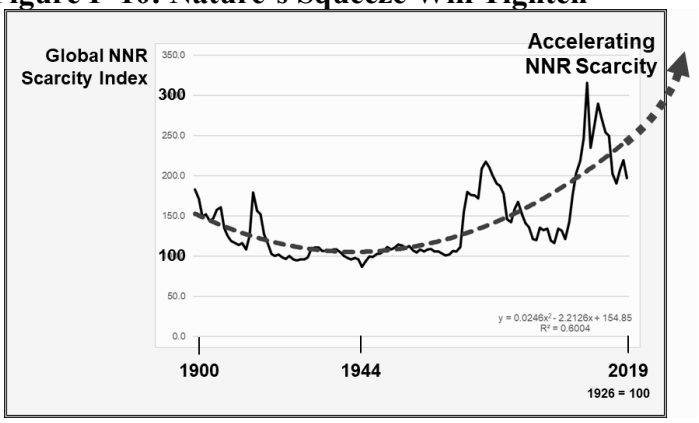
It is unsurprising, therefore, that a post-GR "recovery" has failed to materialize. Rather, human industrialism and industrial humanity have been devolving toward collapse.

Devolution to Collapse

Going forward, as Nature's Squeeze tightens relentlessly and remorselessly, and global human prosperity peaks and enters terminal decline, industrial humanity will crack and human industrialism will collapse.

Nature's Squeeze Will Tighten In attempting to address our enormous and ever-increasing global NNR requirements, we will further deplete Earth's already extensively depleted NNR reserves – which will further decrease NNR quality, which will further increase NNR exploitation costs, which will further increase NNR price trends – and further accelerate global NNR scarcity.

Figure P-10: Nature's Squeeze Will Tighten

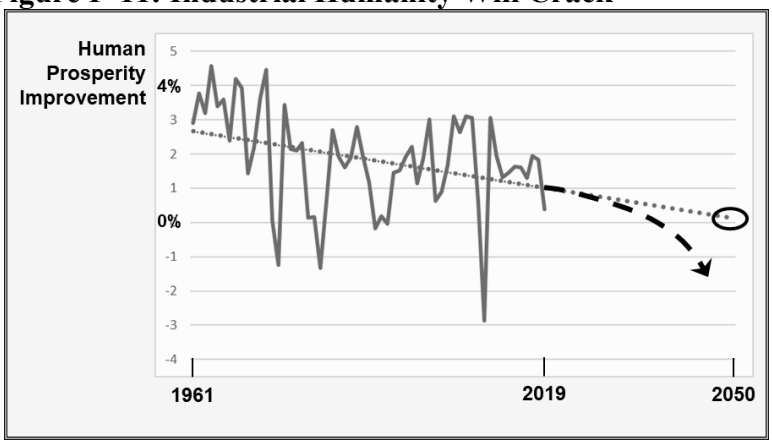


As billions of people seek to perpetuate their industrial existence, as billions more continue to industrialize, and as billions more attempt to industrialize, increasingly unfavorable global NNR demand/supply dynamics will engender increasingly severe and protracted resource wars.

Extensively depleted and irreparably damaged global NNR reserves will ultimately become permanently unproductive.

Industrial Humanity Will Crack Continuously increasing NNR price trends caused by accelerating global NNR scarcity will further suppress global NNR demand and utilization, which will further diminish global human prosperity improvement.

Figure P-11: Industrial Humanity Will Crack



Extrapolating the linear trendline (dotted line) derived from the 1961-2019 global pc GDP growth curve (solid line) indicates 0% global pc GDP growth – "peak human prosperity" – by the middle of the 21st century.

Sources: World Bank and Macrotrends through 2019.

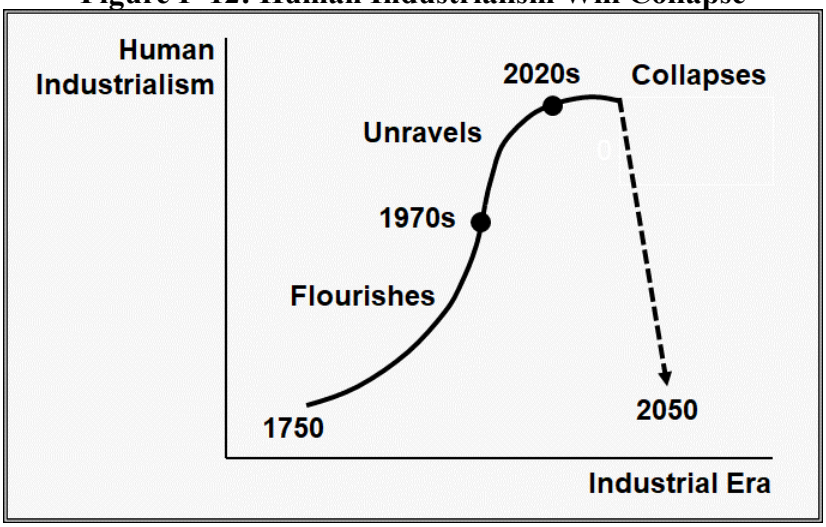
It is almost certain, however, that accelerating global NNR scarcity will cause faltering global human prosperity to accelerate as well, thereby "bending" the declining trajectory of the human prosperity improvement trendline from "downward linear" (dotted line) to "downward accelerating" (dashed line).

As global human prosperity plummets, social cohesion will be displaced by social entropy, and Earth's human population will be ravaged by war, starvation, pestilence, and disease. Self-preservation will become the primary human objective, as the veneer of civilization completely disappears.

Human Industrialism Will Collapse As extensively depleted and irreparably damaged Earth resource reserves become permanently unproductive, all industrialized nations – irrespective of their political ideologies, economic systems, and societal orientations – will collapse, completely and permanently, taking the aid-dependent, non-industrialized nations with them.

Human industrialism and industrial humanity will cease to exist – almost certainly by the year 2050.

Figure P-12: Human Industrialism Will Collapse



Under the best-case post-collapse scenario, a few million *Homo sapiens* will eke out a subsistence level existence by scavenging among the remnants of Earth's once-abundant resources. Under the worst-case scenario, our species will go extinct.

We Are Exceptional… It is certainly not the case that our quest for universal prosperity through global industrialism – and the unsustainable Earth resource utilization behavior by which our quest is enabled – are inherently evil.

We *Homo sapiens* have simply behaved like any species that is introduced into a habitat in which it can succeed. We succeeded – and thrived – because we could.

We have employed our unparalleled ingenuity – our resourcefulness, technological innovations, efficiency improvements, and productivity enhancements – during the past three centuries to dramatically improve our prosperity, through our ever-increasing utilization of Earth's finite and non-replenishing NNRs.

But NOT "Exemptional"… It is the case, however, that despite our possibly justifiable naïveté as we ascended to industrial exceptionalism, and despite the fact that our predicament is an unintended consequence of our understandable efforts to continuously improve our prosperity, neither our NNR utilization behavior nor our industrialized way of life is sustainable.

Humanity's fate was sealed during the 18th century, at the inception of our industrial era. The NNR genie had been released from the bottle and could not be put back. We remained ignorant of our inevitable fate during the 19th and 20th centuries, by misconstruing our windfall of temporary NNR abundance as permanent NNR sufficiency. We are now paying the price for our ignorance.

We will soon discover that while we industrial *Homo sapiens* are indeed exceptional, we are not "exemptional" – having somehow transcended the ecological laws of Nature that apply to all "lesser species". Rather, we are the extraordinarily fortunate beneficiaries of a one-time, rapidly-depleting, natural legacy; and we are the unwitting and tragic victims of our own ingenuity.

Accordingly, there is no "solution" to our geologically-based predicament – that is, a scenario that will culminate in a favorable outcome for humankind. There is only a "resolution" – complete and permanent global societal collapse.

NNR-enabled industrialism is humanity's commitment to impermanence.

Chris Clugston
Industrialism - Our Commitment to Impermanence