

GEONOMICS 101

by Chris Clugston

Human Misperceptions

Water comes from a faucet; food comes from a grocery store; electricity comes from a wall socket; light comes from flipping a switch; heat and air conditioning come from adjusting a thermostat; motor fuel comes from a gas station; cars and trucks come from factories; the myriad consumer products that we use come from Walmart and Amazon; and instantaneous global communications come from pushing buttons on handheld electronic devices – right?

Few of us understand how our modern industrialized existence is enabled; nor do we understand that it is unsustainable. Perhaps we should spend less time watching TV, chatting on social media, and playing with our iToys – and more time studying geonomics.

It's All About Geonomics!

At present, no branch of science focuses specifically on our industrial lifestyle paradigm and how it is enabled. Our currently existing, narrowly focused physical science and behavioral science “silos” permit, at best, cognizance regarding our industrialized existence akin to that of the four blind men describing an elephant.

Regrettably, owing to the lack of a viable and comprehensive framework for perceiving and analyzing our industrialized existence, we develop flawed perceptions, which lead to flawed conclusions, prescriptions, and actions.

Geonomics fills the void.

Geonomics?

Geonomics (geological economics) is a synthesis of physical sciences and behavioral sciences that studies nonrenewable natural resources (NNRs), humanity’s NNR utilization behavior, and the consequences associated with our NNR utilization behavior.

More specifically, geonomics examines the interrelationships and interactions among global NNR requirements, costs, supplies, prices, and demand – the phenomena that govern humanity’s NNR utilization behavior and determine industrialized human prosperity. Drawing extensively from geology and economics,

geonomics provides the analytical framework for understanding humanity’s industrialized existence, how it is enabled, and why it is not sustainable.

Geonomic Fundamentals

Our extraordinary modern industrialized existence is enabled by nonrenewable natural resources (NNRs)¹ and pseudo purchasing power (PPP)². NNRs – fossil fuels, metals, and nonmetallic minerals – enable us to live temporarily beyond our means ecologically. PPP – fiscal imprudence – enables us to live temporarily beyond our means economically, thereby enabling us to live even further beyond our means ecologically.

NNRs

NNRs (nonrenewable natural resources) serve as:

- The raw material inputs to our industrialized economies;
- The building blocks that comprise our industrialized infrastructure and support systems; and
- The primary energy sources that power our industrialized societies.

NNRs play three essential roles in enabling our industrialized way of life:

- NNRs augment renewable natural resources (RNRs) – water, soil, forests, and other naturally occurring biota – by enabling RNRs to be used in ways and at levels that are necessary to support the extraordinary population levels and material living standards associated with industrialized human societies.³ Examples include water storage/distribution systems, food production/distribution systems, and energy generation/distribution systems – which would support only a negligible fraction of today’s global human population in the absence of NNRs.

- NNRs enable infrastructure, goods, services, and energy that are inconceivable through the exclusive utilization of RNRs. Examples include highway systems, communication networks, electric power grids, skyscrapers, cars, airplanes, computers, gasoline stations, and nuclear power plants.
- NNRs enable the enormous real wealth⁴ surpluses that are necessary to support the thriving middle class population segments that differentiate industrialized societies from pre-industrial, RNR-based, agrarian and hunter-gatherer societies.

Accordingly, within the context of our industrial lifestyle paradigm, NNRs enable human prosperity⁵ – defined as economic output and material living standards.

NNRs → Human Prosperity (Economic Output and Material Living Standards)

Unfortunately, we discovered and extracted Earth's highest quality NNRs during the earlier stages of our global NNR exploitation effort – we “picked the low hanging fruit” first. As a result, remaining NNR deposits are of continuously decreasing quality – i.e., fewer in number, smaller in size, less accessible, and of lower grade and purity.⁶

Moreover, despite our remarkable ingenuity in attempting to constrain the costs associated with exploiting NNRs of continuously decreasing quality⁷, NNR discovery, extraction, processing, and provisioning costs are increasing steadily.⁸

So although **plenty** of NNRs remain in the ground – we will never “run out” of any NNR – only a minute fraction of these NNRs will ever be produced. The vast majority of NNRs will never be economically viable – i.e., profitable to produce AND affordable to procure.

And although **more** NNRs of nearly every type will likely be supplied annually during the near term, increasingly there will be **insufficient** economically viable NNRs available to enable the prosperity levels to which those living in the developed world feel entitled and those living in the rest of the world aspire. Global NNR scarcity is becoming increasingly pervasive.

PPP

During the past several decades, those of us who inhabit the industrialized world have attempted to compensate for the prosperity dampening effects associated

with increasingly pervasive NNR scarcity by relying increasingly upon PPP (pseudo purchasing power). We have been able to increase significantly our procurement of NNRs, goods, and services with purchasing power derived from PPP expedients:

- Liquidating our previously created wealth reserves – e.g., depleting our savings, “cashing out” our home equity, and selling our physical assets (ranging from gold jewelry to public property such as toll roads and water/sewer systems);
- Creating and spending enormous sums of fiat currencies⁹ – “faith-based” paper money and digital money, the value of which is only as good as the recipients’ confidence in the issuer;
- Incurring historically unprecedented levels of debt at the individual, corporate, and government levels – debt that we have neither the capacity nor the intent to repay; and
- Underfunding investments critical to our future wellbeing – e.g., “social entitlements,” pensions, retirement accounts, environmental cleanup, and infrastructure upgrades...

...while completely disregarding the increasingly problematic consequences associated with our fiscally imprudent behavior.

That is, although the stimulative effects associated with PPP expedients have enabled industrialized humanity to (temporarily) maintain the illusion of fiscal solvency and perpetuate the lifestyles to which we feel entitled, our unsustainable economic behavior is also causing increasingly frequent and severe economic bubbles and recessions, which in turn are causing intensified global political instability and social unrest.

PPP → Contrived Economic Growth and Increasing Human Prosperity

The Geonomics of NNR Scarcity

Our incessant quest for universal “American-style prosperity” through global industrialization¹⁰ has caused fundamental global geonomic shifts since the latter decades of the 20th century.

Demand Side Geonomic Shifts

On the demand side, approximately 1 billion people occupied industrialized and industrializing nations

during the mid/late 20th century.¹¹ By the year 2000, as a consequence of the industrialization initiatives launched by China, India, Brazil, and other emerging nations in Asia, Africa, and Latin America, that number had increased to over 5 billion.

In order to address the enormous and ever-increasing global NNR requirements resulting from this nearly instantaneous increase in global industrialization, global NNR production (extraction) levels have been enormous and ever-increasing as well.

Select Annual Global NNR Production Levels (Metric tons except Natural Gas)

NNR	2000	2014(e)	Increase
Aluminum	24,300,000	49,300,000	2.0 times
Cement	1,660,000,000	4,180,000,000	2.5 times
Copper	13,200,000	18,700,000	1.4 times
Iron Ore	1,070,000,000	3,220,000,000	3.0 times
Lime	121,000,000	350,000,000	2.9 times
Manganese	6,960,000	18,000,000	2.6 times
Natural Gas (BCF, 2013)	87,100	121,000	1.4 times
Nickel	1,290,000	2,400,000	1.9 times
Phosphate Rock	132,000,000	220,000,000	1.7 times
Zinc	8,770,000	13,300,000	1.5 times

Despite recycling, reuse, conservation, substitution, efficiency improvements, productivity enhancements, and technical innovation, already enormous annual global NNR production levels increased extraordinarily during the early years of the new millennium.¹²

More importantly, early 21st century NNR utilization levels among the newly industrializing nations represented only tiny fractions of their longer term requirements.

Universal Prosperity through Global Industrialization → Enormous and Increasing Global NNR Requirements

Supply Side Geonomic Shifts

On the supply side, owing to persistent and increasing NNR exploitation since the inception of our industrial revolution, NNR quality has been decreasing – a trend that has become increasingly pronounced during the past several decades.

Moreover, the cost disadvantages associated with exploiting NNRs of continuously decreasing quality are overwhelming the cost advantages attributable to human ingenuity¹³ (technology, resourcefulness, efficiency

improvements, and productivity enhancements).¹⁴ The result is lower-quality/higher-cost (less affordable) NNRs.¹⁵

Decreasing NNR Quality in Conjunction with Diminishing Human Ingenuity → Lower-Quality/Higher-Cost NNRs

Increasingly Pervasive NNR Scarcity

Our enormous and ever-increasing global NNR requirements – more people wanting more – in combination with lower-quality/higher-cost global NNR supplies have brought about increasingly pervasive global NNR scarcity.

Enormous and Increasing Global NNR Requirements Addressed by Lower-Quality/Higher-Cost NNRs → Increasingly Pervasive Global NNR Scarcity

Prevailing Global Geonomic Trends

We are pulling out all the stops – engaging in both unsustainable economic behavior and unsustainable ecological behavior – to perpetuate our industrial lifestyle paradigm.

Through historically unprecedented PPP “stimulus” since the Great Recession, we have been able to buy a temporary reprieve from generally diminishing global prosperity. Unfortunately, a stay of execution is not the same as a pardon; and Nature doesn’t grant pardons.

Short Term Trend: Temporary Global Prosperity Plateau

The prevailing short term global geonomic trend, spanning approximately 5 years before and after the year 2015, is a temporary episode of PPP-contrived NNR abundance, which is enabling increasing – albeit anemically increasing – global prosperity.

Recent Past

Owing to historically unprecedented post-recession PPP stimulus – central government debt and central bank interest rate suppression and money printing – lower-quality/higher-cost NNRs that were previously sub-economic have become economically viable to exploit. Within this PPP-distorted global geonomic environment, marginal NNRs have become profitable to produce, despite their low quality and high exploitation costs; and they have become affordable to procure, despite their inordinately high prices.

Select Inflation Adjusted NNR Price Change Data

NNR	2011-2014 Percent Change	20 th Century -2014 Percent Change
Fossil Fuels		
Oil (Index of Brent, Dubai, and WTI)	- 4.8%	+ 309.0%
Natural Gas (Global Index: 2010=100)	+ 5.8%	+ 153.5%
Coal (Australian: 1970-2013)	- 40.6%	+ 35.2%
Fertilizer Components		
Phosphate Rock	- 38.8%	+ 72.9%
Potash	- 29.8%	+ 108.7%
Urea (Nitrogen)	- 22.5%	+ 47.6%
Metals		
Aluminum	- 20.0%	- 20.1%
Copper	- 20.0%	+ 80.1%
Lead	- 10.2%	+ 97.8%
Tin	- 13.5%	+ 44.4%
Nickel	- 24.1%	+ 68.7%
Zinc	+ 1.3%	+ 43.6%
Platinum	- 17.2%	+ 148.1%
Silver	- 44.3%	+ 100.1%
Iron Ore	- 40.3%	+ 117.2%

In 13 of 15 cases, 2014 NNR prices decreased from their 2011 modern industrial era peak levels. In 14 of 15 cases, however, 2014 NNR prices remained inordinately high by mid/late 20th century (1960-1999 average) standards.¹⁶ Unfortunately, the NNR price levels required to generate rapidly increasing global prosperity are those that prevailed during the mid/late 20th century.

The product of our PPP-distorted global geonomic environment is a temporary episode of “PPP-contrived NNR abundance,” which has been sufficient to enable anemic and spotty post-recession global economic growth and prosperity increases, but not sufficient to enable a robust global economic recovery and rapidly increasing global prosperity.

***The Great Recession →
Collapsing Global Prosperity →
Historically Unprecedented PPP to Bolster
Global Prosperity →
PPP-contrived Global NNR Abundance →
Decreasing NNR Prices (2011-2014) →
Stimulated Global NNR Demand and Utilization →
Anemically Increasing Global Prosperity***

Generally speaking, the NNRs that we exploited thus far during the 21st century were **NOT** high-quality/low-cost NNRs, such as those that enabled robustly increasing global economic growth and rapidly increasing global prosperity during much of the 20th century. In most cases, the high-quality/low-cost “low hanging NNR fruit” has long since been picked.

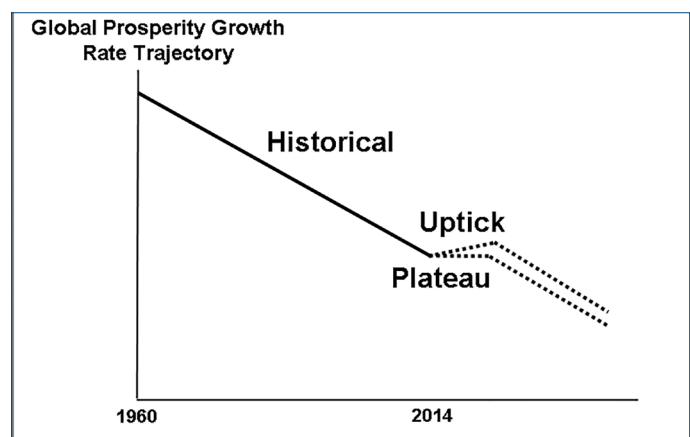
The NNRs that we exploited thus far during the 21st century were of lower and generally decreasing quality; and the costs required to exploit these lower-quality NNRs increased steadily, despite our unparalleled ingenuity in attempting to constrain them.

Ironically, in the absence of historically unprecedented PPP stimulus, it is likely that most of the lower-quality/higher-cost NNRs exploited since the Great Recession would have remained in the ground, and we would be enmeshed in a severe global economic recession or depression at the moment – an eventuality that we have merely deferred, not averted, through our unsustainable economic behavior.

Immediate Future

Barring major unforeseen geonomic disruptions, our episode of anemically increasing global prosperity will likely continue so long as PPP stimulus remains sufficiently effective to enable contrived global NNR abundance – possibly for several years. During this time, we should experience a global prosperity growth rate “plateau” or “uptick” – i.e., a temporary reprieve from our declining global prosperity growth rate trajectory.

Temporary Global Prosperity Growth Rate Plateau or Uptick



During the course of our reprieve, however, decreasing NNR prices will dampen NNR exploitation activity, thereby contributing toward the elimination of global NNR abundance on the supply side. Decreasing NNR prices will also stimulate NNR procurement and utilization levels,

thereby contributing toward the elimination of global NNR abundance on the demand side.

As global NNR supply shortfalls displace abundance, NNR suppliers will be forced to exploit increasingly marginal, lower-quality NNR reserves in order to address the shortfalls. Escalating exploitation costs associated with these lower-quality NNRs will drive up NNR prices, which will suppress global NNR demand and utilization levels, thereby further curtailing already anemic global economic growth.

In their attempts to re-stimulate the sputtering global economy, our political and economic “leaders” will employ additional fiscal and monetary stimulus, which will induce increasingly irresponsible risk taking and malinvestment at the individual, corporate, and government levels.

Within the next few years, one or more of the economic bubbles caused by our ever-increasing fiscal imprudence will burst. Cascading defaults, bankruptcies, and failures will usher in the Greater Recession, as geonomic reality begins to reassert itself.

***Decreasing NNR Exploitation Owing to NNR Abundance →
Increasing Global NNR Supply Shortages →
Increasing NNR Prices →
Suppressed NNR Demand and Utilization →
Diminishing Global Prosperity →
Increasing PPP to Bolster Global Prosperity →
Bursting Economic Bubbles →
The Greater Recession***

The Greater Recession is inevitable because fiscal imprudence (PPP) cannot possibly “fix” our geologically-based predicament.¹⁷

That is, humanity’s industrialized “success” is enabled by our persistent utilization of enormous quantities of finite, non-replenishing, and increasingly scarce NNRs; unfortunately, this natural resource utilization behavior simultaneously undermines our species’ very existence. PPP merely masks the symptoms associated with our predicament and defers its inevitable consequences.

And while the precise timing and circumstances associated with the inception of the Greater Recession cannot be known with certainty, it is clear that the greater our reliance upon PPP, the greater the probability that a calamity-inducing trigger event will occur sooner rather than later, and the greater the severity associated with our ensuing economic calamity.

Unfortunately, as is the case with our global NNR requirements, our PPP reliance is enormous and ever-

increasing – a scenario that we are incapable of modifying.¹⁸ As a species, we will live increasingly beyond our means economically in order to live increasingly beyond our means ecologically, until we can no longer do so.¹⁹

Long Term Trend: Permanently Faltering Global Prosperity

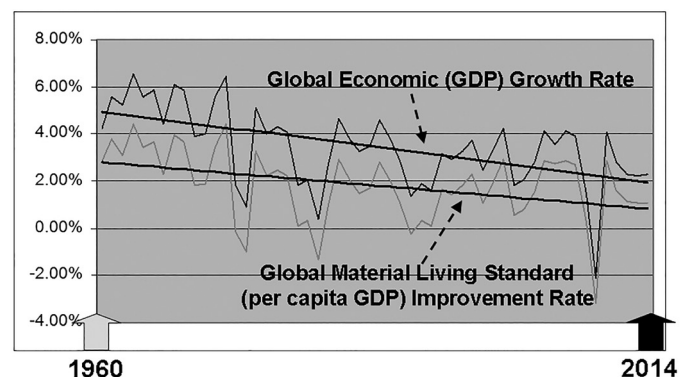
The prevailing long term global economic trend, spanning approximately 50 years before and after the year 2015, is increasingly pervasive global NNR scarcity, which is inducing permanently faltering global prosperity.

Humanity versus Nature

During our modern industrial era, but increasingly over the past several decades, continuously decreasing NNR quality has prevailed over human ingenuity, as evidenced by steadily increasing NNR exploitation costs. The result has been lower-quality/higher-cost (less affordable) NNRs, which in combination with our enormous and ever-increasing global NNR requirements, have caused increasingly pervasive global NNR scarcity and faltering global prosperity.

In less than half a century, global humanity has transitioned from rapidly increasing prosperity – approximately 5% annual global GDP growth and 4% annual global per capita GDP growth during the 1960s – to anemically increasing prosperity – approximately 2% annual global GDP growth and 1% annual global per capita GDP growth today.²⁰

Historical Global Prosperity Growth Trajectories



And as global prosperity continues to falter and our old normal of “continuously more and more” transitions to our new normal of “continuously less and less,”²¹ competition for increasingly scarce NNRs (and RNRs) will devolve into resource wars, which will devolve into global societal collapse through a geonomic chain of events that is being

driven by ever-increasing, geologically-induced, global NNR scarcity.²²

***Enormous and Increasing Global NNR Requirements Addressed by Lower-Quality/Higher-Cost NNRs →
Increasing NNR Prices (Decreasing NNR Affordability) →
Increasing Global NNR Scarcity →
Diminishing Global NNR Demand and Utilization →
Faltering Global Prosperity →
Increasingly Imprudent PPP to Bolster Global Prosperity →
Increasingly Distorted and Bubble Prone Global Economy →
Increasing Economic Fragility, Political Instability, and Social Unrest →
Cascading National Economy Collapses Culminating in Global Societal Collapse***

Humanity's fate was sealed during the 18th century with the advent of industrialism; the NNR genie had been released from the bottle and could not be put back. We remained oblivious to our fate throughout the 19th and 20th centuries by misconstruing our windfall of temporary NNR abundance as permanent NNR sufficiency.²³

Geonomic Reality

Humanity's Destiny

The probability that we will exploit sufficient high-quality/low-cost NNRs to reverse our declining global prosperity trajectory is infinitesimal – given that we have been unable to do so during the past 50 years, despite our extraordinary ingenuity, and given that our global NNR requirements remain enormous and increasing in almost all cases.²⁴

While periodic temporary global prosperity growth rate plateaus and upticks are certainly possible going forward, a resumption of persistently robust global economic growth and rapidly improving material living standards is essentially impossible.²⁵

Our 21st century episode of epidemic global NNR scarcity is Nature's wake up call to the fact that our industrial lifestyle paradigm – the way of life that we in the industrialized world consider “normal” – is anything but normal. Our NNR-enabled industrialized existence is a one-time anomaly that is coming to an end.

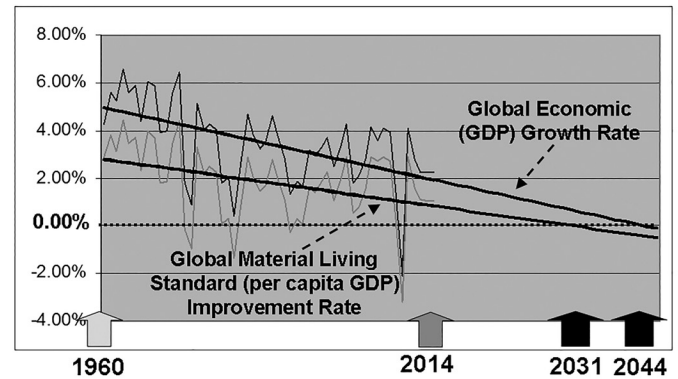
Humanity's Unraveling

It would be convenient if humanity's inevitable unraveling would commence in 1,000 years, 500 years, or even 50 years. We could then dismiss it as a concern for

future generations and continue to enjoy our industrialized way of life in the meantime. Unfortunately, our unraveling is occurring now.²⁶

Should currently declining global prosperity growth trajectories persist, both global economic output (GDP) and global material living standards (per capita GDP) will peak and enter terminal decline by mid-century.²⁷

Projected Global Prosperity Growth Trajectories



We are most certainly feeling the “squeeze” associated with increasingly pervasive global NNR scarcity and faltering prosperity, as evidenced by persistent global economic malaise, increasing global political instability, and escalating global social unrest.²⁸ Both the disenfranchised – the hundreds of millions who are watching their industrialized prosperity slip away – and the denied – the billions of aspirants who are realizing that they will never achieve industrialized prosperity – are becoming increasingly frustrated, angry, and violent.

In the not-too-distant future, it will become universally understood that the only way to “stay even” within our continuously contracting operating environment – much less to improve one's lot – is to take from someone else. Life will become a “negative sum game” within the “shrinking pie” of “continuously less and less.”

Nature Always Bats Last

Regrettably, because it is inconceivable to us that continuously decreasing NNR quality (Nature) will ultimately triumph over human ingenuity, we will fail to acknowledge these inconvenient truths. We will not, therefore, voluntarily terminate our unsustainable natural resource utilization behavior.²⁹

Rather, we will intensify our NNR exploitation efforts in a futile attempt to perpetuate our unsustainable industrial lifestyle paradigm, unravel in the process, and bring about our global societal collapse – almost certainly

by the year 2050.³⁰ All industrialized and industrializing nations, irrespective of their economic systems and political orientations, will collapse, taking the aid-dependent, non-industrialized nations with them.

Under the best case post-collapse scenario, a surviving global human population of a few million will scavenge among the remnants of decimated natural resource reserves and severely degraded natural habitats. Under the worst case scenario, we will completely eliminate our species through global warfare.

And regrettably, the more vigorously we strive to perpetuate our unsustainable industrialized way of life through ever-increasing NNR utilization, the more quickly and thoroughly we will deplete Earth's remaining NNR and RNR reserves – thereby hastening and exacerbating our global societal collapse.

Endnotes

1. NNRs are considered “nonrenewable” natural resources because their reserves in the Earth are not naturally replenished on a time scale that is relevant from the perspective of a human lifespan, in the event that they are replenished at all.
 2. PPP is unsustainable economic behavior – fiscal imprudence – through which populations in Western nations such as the U.S. have increased their consumption of NNRs and derived goods and services, especially during the past several decades.
 3. By enabling us to overexploit RNRs – i.e., to deplete RNR reserves at rates greater than the rates at which they are naturally replenished – our utilization of NNRs further exacerbates our “predicament” by causing ever-increasing RNR scarcity.
 4. Real wealth is obtained from or derived from the following sources:
 - On the ground – livestock and other animal life forms;
 - In the ground – crops and other plant life forms;
 - Under the ground – fossil fuels, metals, and nonmetallic minerals (NNRs); and
 - In the water – fish and other aquatic life forms.
 5. “Human prosperity” is defined by two quantifiable criteria: economic output (GDP) and material living standards (per capita GDP).
 6. “We took the nice, simple, easy stuff first from Australia, we took it from the U.S., we went to South America. Now we have to go to the more remote places.” Glencore CEO, Ivan Glasenberg in the Financial Times describing why his firm operates in the Congo and Zambia. (The point: “Complicated more expensive extraction of metals from increasingly harder to find, lower grade ore bodies in almost inaccessible and hostile parts of the world is going to affect our lifestyles.”) From “A Paradigm Shift, Exiting Easy And Cheap,” SafeHaven, Richard Mills, 2-24-12 – www.safehaven.com/article/24487/a-paradigm-shift-exiting-easy-and-cheap.
- For additional mining industry expert commentary regarding decreasing global NNR quality, see “21st Century NNR Scarcity – Blip or Paradigm Shift?” pages 21-24; Chris Clugston, 2013 – www.wakeupamerika.com/PDFs/21st-Century-NNR-Scarcity_Blip-or-Paradigm-Shift.pdf
7. In the broadest sense, NNR exploitation encompasses activities pertaining to NNR exploration, extraction, processing, and provisioning.
 8. “Although miners are working to control expenses, declining grades will put continual pressure on costs.” From “Tracking the Trends – 2015,” page 5, Deloitte Touche Tohmatsu Limited, Canada, 2015 – www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-tracking-the-trends-2015.pdf.

For mining industry expert commentary regarding increasing NNR exploitation costs, see “21st Century NNR Scarcity – Blip or Paradigm Shift?” pages 21-24.

9. Viable forms of money serve three purposes:
 - Medium of exchange;
 - Unit of account; and
 - Store of value.

I leave it to the reader to decide whether any of today's fiat currencies satisfies all three criteria.
 10. As recently as December 2014, United Nations Secretary-General Ban Ki-moon reaffirmed humanity's goal of universal prosperity through global industrialization, “People want decent jobs, social protection, robust agricultural systems and rural prosperity, sustainable cities, inclusive and sustainable industrialization, and resilient infrastructure and sustainable energy for all.” From “The Road to Dignity by 2030: Ending Poverty, Transforming All Lives and Protecting the Planet,” page 15, United Nations General Assembly, 12-4-14 – www.sustainabledevelopment.un.org/content/documents/5527SR_advance%20unedited_final.pdf.
 11. The 1975 global industrialized population estimate of approximately 1 billion is based on the assumption that roughly 25% of Earth's 4.1 billion people lived in industrialized regions at that time. The global industrialized population included most of Europe, Russia, North America, Japan, Australia, and the four Asian tigers – Taiwan, South Korea, Hong Kong, and Singapore.
 12. Annual global NNR extraction data was obtained from “Historical Statistics for Mineral and Material Commodities in the United States,” U.S. Geological Survey, 2014 – www.minerals.usgs.gov/ds/2005/140/; “Mineral Commodities Summary 2015,” USGS, 2015 – www.minerals.usgs.gov/minerals/pubs/mcs/2015/mcs2015.pdf; and “International Energy Statistics,” U.S. Energy Information Administration, 2015 – www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm.
 13. To some degree, the upward pressure on industry costs which results from these trends [decreasing NNR quality] can be offset by improvements in technology, and typically this has been the experience of the past 30 years. However, there is no law which says that this has to be the case and, for a number of mineral commodities, it would appear that the declining quality of reserves, combined with other factors like higher energy prices, are pushing up net production costs, notwithstanding continuing technological progress.” From “Mining Investment Trends and Implications for Minerals Availability,” David Humphreys, Polinares (EU Policy on Natural Resources), page 9, 2012 – www.polinares.eu/docs/d2-1/polinares_wp2_chapter3.pdf.
- For mining industry expert commentary regarding the ongoing conflict between human ingenuity and decreasing NNR quality, see “21st Century NNR Scarcity – Blip or Paradigm Shift?” pages 21-24.
14. One type of human ingenuity enables us to exploit NNRs more cost effectively, thereby permitting us to derive increasing benefits from NNR related investments. The other type of human ingenuity enables us to identify new NNR uses, thereby increasing our total NNR utilization levels. Unfortunately, while the former type of human ingenuity is experiencing diminishing returns, the latter type knows no bounds.
 15. For additional information regarding diminishing returns on investments in NNR exploitation, see “21st Century NNR Scarcity – Blip or Paradigm Shift?” pages 4-5.
 16. Included in the Analysis are 15 fossil fuels, metals, and major fertilizer components for which the World Bank maintains inflation adjusted pricing data between the years 1960 and 2014 (except coal, 1970-2013) – www.econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPPECTS/0,,contentMDK:21574907~menuPK:7859231~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html. These 15 NNRs provide a suitable proxy for the global NNR prices and price trajectories that prevailed during the 1960-2014 period.
 17. For an explanation of humanity's predicament, see “Austerity – Our ‘New Normal’” page 5; Chris Clugston, 2012 – www.wakeupamerika.com/PDFs/Austerity-Our-New-Normal.pdf.
 18. To understand why humanity will continue to pursue unsustainable natural resource utilization behavior, see “Humanity vs. Nature – Winner Take All” (“The ‘Squeeze’ is On” segment), Chris Clugston, to be published in “Free Inquiry Magazine,” June 2015 – www.secularhumanism.org/index.php/articles/category/freeinquiry.

19. In order to rationalize our ever-increasing reliance on PPP, we perpetrate the myth that today's fiscal imprudence will create sufficient real wealth to enable future generations to live very prosperous lives AND discharge the obligations incurred as a result of today's fiscal imprudence. Precisely how this scenario can possibly occur is never explained.

In reality, we are pulling out all the stops to perpetuate our industrial lifestyle paradigm at the expense of everybody and everything, past (liquidating previously created wealth reserves), present (relying increasingly upon PPP stimulus), and future (underfunding investments in our future wellbeing).

20. Global GDP and global per capita GDP data can be found at "World Development Indicators," World Bank, 2015 – www.google.com/publicdata/explore?ds=d5bncppjof8f9_&met_y=ny_gdp_mktp_cd&idim=country:USA&dl=en&hl=en&q=us+gdp#!ctype=l&strail=false&bcs=d&nselm=h&met_y=ny_gdp_mktp_cd&scale_y=lin&ind_y=false&rdim=region&idim=country:USA&ifdim=region&tdim=true&hl=en_US&dl=en&ind=false; 2014 GDP and per capita GDP estimates were derived from "GDP Growth (annual %)," The World Bank, 2014 – www.data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?cid=GPD_30.
21. For details regarding humanity's transition from "continuously more and more" to "continuously less and less," see "21st Century NNR Scarcity – Blip or Paradigm Shift?" page 13.
22. For a details regarding the consequences associated with increasingly pervasive global NNR scarcity, see "Scarcity – Humanity's Final Chapter?" pages 87-94, Chris Clugston, 2012, Booklocker.com – www.nnrscarcity.com.
23. For details regarding the basis for our misperception regarding permanent NNR sufficiency, see "Whatever Happened to the 'Good Old Days?'" pages 4-5, Chris Clugston; "Negative Population Growth," 2014 - www.npg.org/wp-content/uploads/2014/03/WhateverHappenedGoodOldDays.pdf.
24. Given that global prosperity faltered during our old normal of "continuously more and more," which was characterized by high-quality/low-cost NNRs, a smaller NNR-dependent industrialized population, a smaller population aspiring to industrialization, fewer NNR uses, and historically unprecedented human ingenuity; it is completely unrealistic to expect a return to rapidly increasing global prosperity during our new normal of "continuously less and less," which is

characterized by lower-quality/higher-cost NNRs, significantly increased industrialized and industrializing populations, and myriad new NNR uses.

Human ingenuity cannot possibly prevail within today's more challenging geonomic environment, when it failed to prevail within yesterday's less challenging geonomic environment.

25. Absent immediate, enormous, and continuous high quality/low cost NNR discoveries in heretofore untapped target areas (e.g., the ocean floor, ocean waters, under the polar ice caps, and Earth's mantle) and continuous and extraordinary increases in NNR exploitation efficiencies, which would merely buy us time in the extremely unlikely event that they were to occur, a return to vigorously increasing global prosperity is impossible.
26. For details regarding humanity's unraveling, see "Austerity – Our 'New Normal'" pages 12-13.
27. The graph is a linear extrapolation of World Bank "World Development Indicators" through the year 2050.
28. The Economist Intelligence Unit forecasted the likelihood of future social unrest and political instability in "Cassandra, the World in 2014" – www.economist.com/blogs/theworldin2014/2013/12/social-unrest-2014; the International Labor Organization maintains a "Social Unrest Index" – www.ilo.org/newyork/voices-at-work/WCMS_217280/lang-en/index.htm. Also see the Fund for Peace "2014 Fragile States Index" – www.ffp.statesindex.org/rankings-2014; 126 of 178 analyzed nations (71%) received an "alert" or "warning" status. The most telling analysis of increasing social unrest is a time series map developed by John Beielor depicting the increasing incidence of global protests between 1979 and 2013 – www.johnbeielor.org/protest_mapping/ (from www.johnbeielor.org) using Google's GDELT dataset - www.gdeltproject.org/.
29. From "The Most Endangered Species," Chris Clugston, "Humanist Perspectives Journal," pages 8-10, Summer 2014 (Issue 189) – www.humanistperspectives.org/issue189/clugston.html.
30. For a detailed discussion regarding the inevitability associated with humanity's imminent global societal collapse, see "Scarcity – Humanity's Final Chapter?" pages 92-93.



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He has sought to quantify from a combined ecological and economic perspective the extent to which America and humanity are living unsustainably beyond our means, and to articulate the causes, magnitude, implications, and consequences associated with our "predicament." His work includes *Scarcity – Humanity's Final Chapter?* and numerous related research papers and articles.

NOTE: The views expressed in this article are those of the author and do not necessarily represent the views of NPG, Inc.



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