Three Strikes—You're Out!

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Industrial supremacy among nations is enabled by abundant supplies of domestically available, economically viable NNRs (nonrenewable natural resources) i.e., fossil fuels, metals, and nonmetallic minerals. Since the inception of humanity's industrial revolution in the mid-eighteenth century, three nations that were naturally endowed with domestic NNR abundance — Great Britain, America, and China — have emerged in succession as global industrial leaders.

In the case of Great Britain and America, as domestic NNR abundance was displaced by domestic NNR scarcity, industrial prominence diminished. Regrettably, as China attempts to ascend to global industrial supremacy during the twenty-first century, it is becoming increasingly clear that the causal relationship between NNR scarcity and industrial demise, which exists at the sub-global level, exists at the global level as well.

STRIKE ONE — THE ERA OF BRITISH INDUSTRIAL SUPREMACY

Industrialism 1 — humanity's first industrial revolution — commenced in the Netherlands, Sweden, Belgium, and, most notably, Great Britain during the mid-eighteenth century, from whence it spread to most of Western Europe during the nineteenth century. Owing to Britain's dominance with respect to domestic NNR reserves during most of the nineteenth century, Industrialism 1 became the era of British industrial supremacy. During the nineteenth century[1]:

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- Annual British coal extraction levels ranged between 60 percent and 90 percent of global levels;
- Annual British iron ore extraction represented 33 percent to 50 percent of global totals;
- Annual British copper and tin extraction levels averaged 50 percent of global levels; and
- Annual British zinc extraction exceeded 25 percent of global totals.

By the dawn of the twentieth century (1900), British GDP accounted for 9.7 percent of global GDP.[2,3]

During its period of rapid industrialization, Great Britain had also become increasingly reliant upon riskier and costlier imported NNRs, owing to the increasing depletion of its once abundant domestically available, economically viable NNRs, which had enabled its ascendance to global industrial supremacy.

Annual British zinc extraction peaked in approximately 1800; annual British copper extraction peaked in 1861, British lead extraction peaked in 1870, tin in 1871, iron ore in 1882, and coal in 1913.[1,4]

As Great Britain's domestic NNRs, which had enabled an island the size of Kansas to control nearly one quarter of the world's population and land area, became substantially depleted by the early twentieth century, its global economic dominance declined as well. Britain's share of global GDP decreased from 9.7 percent in 1900 to 6.6 percent by the end of World War II (1945), to 3.8 percent by the time of the first oil shock (1973).[2,3]

And, owing to Britain's substantially depleted NNR reserves by the year 2015[6,7]:

- British oil and natural gas extraction levels approximated 1 percent of global totals, and British coal extraction had become negligible as a percentage of the global total;
- British bauxite extraction and aluminum production levels were negligible, British iron ore extraction had become negligible, British steel production approximated 1 percent of the global total, and British copper, lead, tin, zinc, and nickel extraction levels had all become negligible;

• British potash extraction approximated 2 percent of the global total, while British phosphate rock extraction was negligible;

• British cement production and sulfur extraction levels were negligible as percentages of global totals, while Britain's gypsum extraction accounted for less than 1 percent of the global total; and...

…Great Britain's 2015 GDP had decreased to 2.3 percent of global GDP, as the once-powerful, NNR-based, production-oriented British economy had become dominated by its "service sector," which creates no NNR-based real wealth.[2,3]

2010-2014 EUROPEAN (EU) NNR IMPORT RELIANCE

EU IMPORT PERCENTAGE	NNRs IMPORTED BY EUROPE (EU)
2%-20% Imported	Hafnium, Nitrogen (Ammonia), **Steel**, Talc
21%-40% Imported	Arsenic, Cobalt, Feldspar, Gallium, Lithium, Magnesium Compounds, **Potash**
41%-60% Imported	**Aluminum**, **Coal**, **Copper**, Mica, Tungsten
61%-80% Imported	Barite, Fluorspar, Germanium, **Natural Gas**, Silicon, Titanium Mineral Concentrates, **Zinc**
81%-99% Imported	Bauxite, Bromine, **Iron Ore**, Manganese, **Nickel**, **Oil**, **Phosphate Rock**, Vanadium
100% Imported	Antimony, Asbestos, Beryllium, Bismuth, Boron, Diamond (Industrial), Graphite, Helium, Indium, Iodine, Magnesium Metal, Mercury, Molybdenum, Niobium, Platinum Group Metals, Rare Earth Metals, Rhenium, Scandium, Tantalum, **Tin**, Uranium, Yttrium, Zirconium
Percentage Unavailable	Abrasives, Cesium, Garnet (Industrial), Gold, Quartz Crystal, Rubidium, Silver, Thorium, Titanium Metal, Vermiculite, Wollastonite, Zeolites

Bold: Indispensable NNR

Moreover, the fate experienced by Great Britain as a consequence of increasingly pervasive domestic NNR scarcity was likewise experienced by Europe as a whole, as a direct consequence of advanced European NNR depletion and increasing NNR import reliance. In 1860, over 60 percent of global (metals) mining activity occurred in Europe; by the year 1900, the percentage had decreased to 40 percent, by 1950, to 13 percent, and by 2010, to 3 percent.[8]

In 1870, Europe's share of global GDP was approximately 38 percent, a share that persisted until the inception of World War I in 1913. By 1973, Europe's share of global GDP had decreased to 29 percent; and by the early twenty-first century (2008), European GDP had further decreased to 19.1 percent of the global total — approximately one half of its share a century earlier.[9]

By the early twenty-first century, Europe had also become import reliant with respect to the vast majority of industrially critical NNRs.[10,11]

STRIKE TWO — THE ERA OF AMERICAN INDUSTRIAL SUPREMACY

Industrialism 2 — humanity's second industrial revolution — which commenced during the late nineteenth century, featured the continuation of "Western industrialization," this time led by the United States. At the end of World War II (1945), during the era of America's undisputed global industrial supremacy[12]:

PEAK US NNR EXTRACTION/PRODUCTION YEARS

US PEAK	NNRs
Pre-1950	Antimony, Arsenic, Bismuth, **Bauxite**, **Coal (Anthracite)**, Fluorspar, Graphite, Magnesium Metal, Manganese, Mercury, Niobium, Silver, Strontium, Tantalum, **Tin**
1950-1974	Abrasives, Asbestos, Cadmium, Cesium, Chromium, Clays, Cobalt, Helium, Indium, **Iron Ore**, **Lead**, Lithium, Magnesium Compounds, **Oil (Conventional)**, **Potash**, Selenium, Sodium Sulfate, **Steel**, Tellurium, Thorium, Titanium Minerals, Tungsten, Vermiculite, **Zinc**
1975-1999	**Aluminum**, Barite, Beryllium, Boron, Bromine, **Coal (Bituminous)**, **Copper**, Feldspar, Gallium, Garnet, Germanium, Gold, Hafnium, Iodine, Mica (Scrap), Molybdenum, **Nickel**, Nitrogen (Ammonia), Peat, Perlite, **Phosphate Rock**, Quartz Crystal, Rare Earth Minerals (REMs), Rhenium, Rubidium, Silicon, **Sulfur**, Talc, Thallium, Titanium Metal, Uranium, Vanadium, Zirconium

Bold: Indispensable NNR

• Annual U.S. coal extraction accounted for 49 percent of global extraction, U.S. oil for 68 percent, and U.S. natural gas for 87 percent;

• Annual U.S. iron ore extraction represented 56 percent of the global total, U.S. copper 48 percent, U.S. zinc 47 percent, U.S. tin 46 percent, U.S. lead 36 percent, and U.S. bauxite 29 percent — the U.S. also produced 67 percent of global steel and 52 percent of global aluminum in 1945;

• Annual U.S. phosphate rock extraction accounted for 50 percent of the global total, U.S. potash extraction for 41 percent; and

• Annual U.S. cement and gypsum extraction stood at 35 percent of global extraction, while U.S. sulfur accounted for 72 percent of the global total.

In 1945, America, a nation that contained less than

6 percent of the global population, produced an astounding 30.6 percent of global GDP.[2,3]

As was the case with Great Britain during the eighteenth and nineteenth centuries, America's period of rapid industrialization during the nineteenth and twentieth centuries ravaged its domestic NNR reserves, resulting in peak U.S. extraction and production levels associated with the vast majority of industrially critical NNRs.[12,13]

And, like Great Britain and Europe during the nineteenth century, America became increasingly reliant upon riskier and costlier imported NNRs during the twentieth century. By 1995, America had become import reliant with respect to 49 industrially critical NNRs — 100 percent import reliant in 8 of the 49 cases. Appallingly, by 2016, only 21 years later, American import reliance had increased from 49 NNRs to 83 NNRs — 100 percent import reliance had increased from 8 NNRs to 20.[5,6,14]

2016 U.S. NNR IMPORT RELIANCE	
U.S. IMPORT PERCENTAGE	**NNRs IMPORTED BY THE US**
2%-20% Imported	Beryllium, **Cement**, Feldspar, **Gypsum**, **Natural Gas**, **Nickel**, Perlite, **Phosphate Rock**, Pumice, **Sulfur**, Talc
21%-40% Imported	Cadmium, **Copper**, **Lead**, Magnesium Metal, Nitrogen (Fixed), **Oil**, Salt, Silicon, **Steel**, Tungsten, Vermiculite
41%-60% Imported	Bromine, **Aluminum**, Chromium, Hafnium, Iodine, Lithium, Magnesium Compounds, Mica (Scrap), Palladium, Titanium Metal, Zirconium
61%-80% Imported	Abrasives, Barite, Cobalt, Diamond (Industrial), Garnet, Peat, Platinum, Silver, Tellurium, **Tin**
81%-99% Imported	Antimony, Bismuth, Germanium, **Potash**, Rhenium, Titanium Mineral Concentrates, Uranium, **Zinc**
100% Imported	Arsenic, Asbestos, **Bauxite**, Cesium, Fluorspar, Gallium, Graphite, Indium, Manganese, Mica (Sheet), Niobium, Quartz Crystal, Rare Earth Minerals (REMs), Rubidium, Scandium, Strontium, Tantalum, Thallium, Thorium, Vanadium, Yttrium
Percentage Unavailable	Gold, Mercury
Bold: Indispensible NNR	

During the twentieth century, as U.S. NNR depletion and NNR import reliance increased, U.S. NNR extraction and production levels as percentages of global totals decreased — significantly. By the year 2015:[12, 15]

- Annual U.S. coal extraction had decreased from 49 percent of the global total in 1945 to 10 percent, U.S. oil from 68 percent to 22 percent, and U.S. natural gas from 87 percent to 14 percent;
- Annual U.S. iron ore extraction had decreased from 56 percent of the global total in 1945 to 2 percent, U.S. copper from 48 percent to 7 percent, U.S. zinc from 47 percent to 7 percent, U.S. tin from 46 percent to less than 1 percent, U.S. lead from 36 percent to 7 percent, and U.S. bauxite from 29 percent to 0 percent — U.S. steel production had decreased from 67 percent of total global output in 1945 to 5 percent in 2015, and US aluminum production decreased from 52 percent to 1 percent;
- Annual U.S. phosphate rock extraction had decreased from 50 percent of the global total in 1945 to 11 percent, U.S. potash extraction decreased from 41 percent to 2 percent; and
- Annual U.S. cement production had decreased from 35 percent of 1945 global output to 2 percent in 2015, U.S. gypsum extraction decreased from 35 percent to 6 percent, and U.S. sulfur extraction decreased from 72 percent to 14 percent.

Not surprisingly, as had been the case with Great Britain and Europe, as U.S. NNR extraction and production dominance waned, so too did US economic dominance. U.S. GDP as a percentage of global GDP (PPP, or purchasing power parity) decreased from 30.6 percent in 1945, to 20.5 percent in 1973, to 15.7 percent in 2015 — U.S. GDP as a percent of the global total had been halved in only 70 years.[2,3]

And like the British economy and other NNR-deficient Western economies, the twentieth century U.S. economy transitioned (devolved) from a "production economy" to a "consumption economy," anchored by its "service sector" — an economy that created decreasing amounts of NNR-based real wealth — a transition that paralleled America's declining global industrial prominence.

STRIKE THREE — THE ERA OF CHINESE INDUSTRIAL SUPREMACY?

Industrialism 3 — humanity's third industrial revolution — which commenced in Japan following World War II, spread to the Four Tigers (Taiwan, South Korea, Singapore, and Hong Kong) shortly thereafter, and was ultimately commandeered by China during the latter decades of the twentieth century, has been primarily an "Eastern" phenomenon.

Since the dawn of the new millennium and the emergence of China as the heir apparent to global industrial supremacy, China has dominated the world in terms of domestic NNR extraction and production, just as Great Britain had during the nineteenth century and America had during the twentieth century.

In the year 2015:[6, 15]

- Annual Chinese coal extraction accounted for 48 percent of global extraction;
- Annual Chinese iron ore extraction represented 16 percent of the global total, Chinese zinc 38 percent, Chinese tin 36 percent, Chinese lead 50 percent, and Chinese bauxite 25 percent — China also produced 50 percent of global steel and 54 percent of global aluminum in 2015;
- Annual Chinese phosphate rock extraction accounted for 53 percent of global extraction; and
- Annual Chinese cement production stood at 57 percent of the global total, and Chinese gypsum extraction at 50 percent.

In addition, China led the world during 2015 in the extraction/production of abrasives (50+ percent), antimony (77 percent), arsenic (68 percent), barite (39 percent), bismuth (73 percent), cadmium (32 percent), fluorspar (66 percent), gallium (90+ percent), germanium (71 percent), gold (15 percent), graphite (65 percent), indium (44 percent), lime (65 percent), magnesium compounds (69 percent), magnesium metal (87 percent), mercury (89 percent), mica (69 percent), molybdenum (40 percent), nitrogen/ammonia (33 percent), perlite (40 percent), rare earth minerals (83 percent), salt (23 percent), selenium (percent N/A), silicon (64 percent), strontium (51 percent), talc (26 percent), thallium (percent N/A), titanium metal (35 percent), tungsten (82 percent), vanadium (55 percent), wollastonite (61 percent), yttrium (~100 percent), and zeolites (71 percent).[6]

China's current NNR extraction/production dominance is made even more remarkable by the fact that global humanity's NNR requirements and corresponding total annual NNR extraction and production levels have increased extraordinarily since the days of Industrialism1 and Industrialism2.[15, 16]

SELECT ANNUAL GLOBAL NNR EXTRACTION/PRODUCTION LEVELS (METRIC TONNES)

NNR	BRITISH SUPREMACY	AMERICAN SUPREMACY	CHINESE ASCENDANCE
	1875 Global Extraction	1945 Global Extraction	2015 Global Extraction
Coal	285 million	1.2 billion	5.2 billion
Iron Ore	25 million	159 million	2.3 billion
Copper	150 thousand	2.1 million	19.1 million
Phosphate Rock	750 thousand	10.9 million	241 million
Cement	5 million	50 million	4.1 billion

In 2015 global NNR extraction levels dwarfed 1945 levels, just as 1945 global NNR extraction levels dwarfed 1875 levels. China's annual domestic NNR extraction/production levels, which have dominated total global levels during the twenty-first century, were inconceivable for America during the twentieth century and physically impossible for Great Britain during the nineteenth century.[1, 12, 15, 16]

SELECT ANNUAL DOMESTIC NNR EXTRACTION AND PRODUCTION LEVELS (METRIC TONNES)

NNR	BRITISH SUPREMACY	AMERICAN SUPREMACY	CHINESE ASCENDANCE
	1875 British Extraction	1945 American Extraction	2015 Chinese Extraction
Coal	230 million	600 million	2.5 billion
Iron Ore	10 million	89 million	370 million
Copper	75 thousand	1.0 million	1.7 million
Phosphate Rock	0	5.5 million	128 million
Cement	2 million	17.5 million	2.3 billion

China's enormous domestic NNR reserves have been the primary enabler of its meteoric ascendance to global economic leadership. By the end of 2015, China had surpassed America as the world's GDP leader with a 17.2 percent share of global GDP (PPP) — an increase from only 2.2 percent as recently as 1973.[2,17]

And, given the fact that China's GDP is still increasing at an annual rate of 6 to 7 percent, while global (and U.S.) GDP is barely increasing at 2 percent per annum, it is not unreasonable to expect that China's share of global GDP will continue to increase, so long as its domestically available, economically viable NNRs remain sufficient — a scenario that is increasingly doubtful.

China's extraordinary NNR extraction/production levels and resulting economic "miracle" have been achieved at a formidable price — extremely rapid domestic NNR reserve depletion. Given current Chinese NNR reserve-to-production (R/P) ratios — the number of years in which an existing proven NNR reserve will be totally depleted, given the current annual extraction level — it appears that China is depleting its domestic NNR reserves far more rapidly than was the case with Great Britain and America.

Chinese R/P ratios associated with the following indispensable NNRs are either low or exceedingly low: iron ore — 33 years, coal — 31 years, natural gas — 28 years, nickel — 28 years, phosphate rock — 23 years, copper — 16 years, bauxite — 15 years, oil — 12 years, tin — 11 years, zinc — 9 years, and lead — 7 years. In the absence of new economically viable domestic discoveries, Chinese reserves associated with these NNRs will be totally depleted by the year 2050, or well

before.[12,18]

In order to maintain its current annual NNR utilization levels — much less to increase its NNR utilization levels sufficiently to perpetuate robust domestic economic growth and support international projects such as the "One Belt One Road" initiative – China must discover substantial additional domestic economically viable NNRs, increase its NNR imports, or both.

To the extent that China attempts to increase its NNR imports — which it must, even under the most optimistic domestic NNR depletion and discovery scenarios — it will exert increasing competitive pressure on Europe, America, Russia, and the rest of the industrialized and industrializing world for dwindling global NNR supplies.

And Chinese NNR import requirements and reliance are already enormous[19, 20, 21]:

> China imports approximately 88 percent of its iron ore, 68 percent of its oil, 65 percent of its bauxite and copper, 57 percent of its sulfur, over 50 percent of its nickel and potash, 34 percent of its natural gas, 25 percent of its lead, 17 percent of its tin, 12 percent of its gypsum, and over 10 percent of its zinc;
>
> China also imports 100 percent of its platinum group metals, 98 percent of its chromium, 96 percent of its cobalt, 85 percent of its manganese, and over 75 percent of its uranium; and
>
> China is the number one global importer of lithium, niobium, silver, tantalum, and thorium.

But while the NNR-related challenges confronting China are certainly daunting, similar challenges were faced, and overcome, by Great Britain and America during their respective periods of ascendance to global industrial supremacy. Accordingly, China's ascendance to global industrial supremacy during the twenty-first century would seem inevitable. *Except that this time really IS different*.

In addition to accelerating the depletion of domestic Chinese NNR reserves, China's historically unprecedented demand for NNRs has significantly accelerated the depletion of remaining global NNR reserves — a reality that became painfully evident during the episode of epidemic global NNR scarcity that precipitated the Great Recession in 2008.[22]

Going forward, global humanity's annual NNR requirements are expected to remain enormous and ever-increasing[23,24,] while the quality associated with Earth's remaining NNR supplies will continue to decrease; i.e., new NNR discoveries/deposits are fewer, smaller, less accessible, and of lower grade and purity — and are increasingly costly to exploit.[25,26]

Regrettably therefore, owing to lower quality/higher cost global NNR supplies within the context of global humanity's enormous and ever-increasing NNR requirements — i.e., increasingly pervasive global NNR scarcity — Earth's remaining NNRs cannot possibly enable China, or any other nation, to achieve global industrial supremacy during the twenty-first century.

YOU'RE OUT! THE CUMULATIVE EFFECTS OF SUB-GLOBAL NNR SCARCITY

As Great Britain depleted its economically viable domestic NNR reserves during the nineteenth century, it was able to import NNRs from its global network of resource-rich colonies, protectorates, and territories, which included Canada, Australia, and India. Imported NNRs from these and other foreign sources enabled Britain to temporarily extend its industrial supremacy.

As America depleted its economically viable domestic NNR reserves during the twentieth century, it expanded its NNR exploitation efforts (and hegemony) into most of the rest of the previously unexplored world, including resource-rich nations in Latin America, Asia, and Africa. "Cheap" imported NNRs from these foreign sources enabled America to temporarily extend its industrial supremacy.

During the early decades of the twenty-first century, as China rapidly depletes its economically viable domestic NNR reserves, it is actively staking claims in the few remaining unexploited global NNR frontiers, while simultaneously attempting to "jump" claims in areas previously staked out by Western nations during Industrialism 1 and Industrialism 2. Global competition for increasingly scarce NNRs is becoming intense.

And, as the four major global industrial powers — Europe (EU), America, China, and Russia — seek to secure sufficient NNR supplies to perpetuate their industrialized societies during the coming decades, competition for remaining globally available, economically viable NNRs will become increasingly intense.

Inevitably, as the NNR-deficient industrial powers resort increasingly to political alliances, economic alliances, military alliances, proxy wars, and direct military confrontation, competition for remaining NNRs will devolve into conflict within the negative sum game of increasingly pervasive global NNR scarcity.

Going forward, in the absence of a continuous series of "human ingenuity miracles," i.e., enormous new *economically viable* discoveries of literally all fossil fuels, metals, and nonmetallic minerals from sources that are currently woefully sub-economic, such as the Arctic, Earth's oceanic crust, Earth's mantle, the ocean floor, and ocean water — beginning yesterday…increasing global conflict for Earth's remaining NNRs will further devolve

into industrial humanity's self-inflicted global societal collapse, almost certainly by the year 2050.

We need only examine the NNR depletion histories associated with individual industrialized nations and regions to understand the current global picture. The same NNR depletion cycle that exists nationally and regionally, exists globally as well — and increasingly pervasive NNR scarcity is the inevitable result.

Global NNR scarcity is simply the aggregation and culmination of all previously occurring sub-global NNR scarcity episodes. But whereas imported NNRs have been available as "safety valves" to alleviate national and regional NNR scarcity, no such safety valves exist at the global level. ■

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The Benefits of Population Reduction to a Developed Country

Some proponents of continuing mass immigration, such as *The Wall Street Journal*'s William McGurn, argue that developed countries' populations will shrink without more fertile newcomers. Echoing the late University of Maryland business professor Julian Simon, they claim that a declining population must necessarily hurt a country's future well-being. This proposition was challenged by Ezra. J. Mishan (1917-2014), Professor of Economics at the London School of Economics. Writing in *The Social Contract* (Fall 2001, p. 3), he outlined some of the benefits of a reduction in population to a developed country:

"...that Japan and those Western European countries with declining populations face a dilemma: In order to maintain cultural integrity, they must limit immigration yet they can't because of 'economic necessity.'

In a country with a diminishing population, aggregate consumer demand declines along with the workforce, the reverse being true of a country with an expanding population.

But bearing in mind that in ordinary economic circumstances markets are continually having to adjust to quite rapid changes in the pattern of consumer demand, in resource availabilities, and in technologies, gradual changes in population size are unlikely to cause any serious dislocation.

More important, a reduction in the population of a developed country is hardly to be deplored on economic grounds. Certainly countries with populations as small as those in Switzerland, Norway, or Singapore are among those with the highest living standards in the world. Specific advantages of a reduction in population size include an increase in land and resources per capita, and a decrease in the amount of pollution, garbage, and traffic congestion. Moreover, with the associated decline in the volume of imports relative to exports, an improvement in the terms of trade which entails a reduction in the prices of imported goods and material is experienced.

In sum, a developed country that is enjoying a declining population is twice blessed if it is able to prevent immigration. For along with an improvement in living standards and amenity it also avoids racial tensions and cultural conflict." ■

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