Naturalizing capitalism: The next Great Transformation

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ABSTRACT

Capitalism is arguably the most amazing cultural and economic product of humankind. It nurtured political liberty in Europe; it ushered in the industrial revolution in Britain and then around the world; it raised incomes everywhere; and it cleared away centuries of obscurantism and superstition. But it also brought into being a 'spirit of capitalism' that is individualist, expansive, acquisitive, ruthlessly rational and insatiable. This spirit has been responsible for commodifying relations and turning the natural world into a 'resource base' on the one hand, and a sink for wastes at the other. The industrial scale of this objectification and destruction of the natural setting has proceeded to the point where it is global, and now threatens our industrial civilization with collapse. My purpose in this paper is to sketch an account of how industrial capitalism might be 'naturalized', so that it continues to grow and deliver improvements in the quality of life without destroying humankind's resource base, and the biosphere as well. My focus is on rules and institutions rather than policies or prescriptions. My argument is that a green economy is already growing within the old, fossil-fuel economy, and that through competitive dynamics it will dominate by mid-century – unless blocked politically by vested interests.

The Puritan wanted to work in a calling; we are forced to do so. For when asceticism was carried out of monastic cells into everyday life, and began to dominate worldly morality, it did its part in building the tremendous cosmos of the modern economic order. This order is now bound to the technical and economic conditions of machine production which to-day determine the lives of all the individuals who are born into this mechanism...with irresistible force. Perhaps it will so determine them until the last ton of fossilized coal is burnt. (Max Weber, Protestant Ethic and the Spirit of Capitalism)

1. Introduction

Industrial capitalism has revealed itself to be the most powerful transformative agent found in the world today. Its appearance in Britain in the second half of the 17th century, powered by access to the new fossil fuels, unleashed astonishing gains in productivity associated with rises in income, so that it was emulated everywhere. Polanyi [1] aptly called this the Great Transformation, in the sense that nothing would be the same again. Capitalism was indeed an amazing invention of humankind. Its appearance in cities led to demands for independence and liberties that today we take for granted in the West, and which are now spreading worldwide. It ushered in the Industrial Revolution which applied fossil fuels to production, along with new mechanical inventions, thus starting the world on a trajectory of industrialization and
modernization that is bringing more and more of the world’s people into its orbit. But it has a dark side, as is now also universally recognized. Polanyi called this the ‘counter-movement’ to the sundering of social bonds, the uprooting of workers to become the commodity ‘labor’ and the destruction of nature. At the time he was writing, in the 1940s, the process had already reached an advanced stage, and appeared to be bringing down the whole civilized edifice through Nazism and fascism. As we know, a new kind of capitalism was then being fashioned, in the US New Deal and Keynesian economics, and this ushered the system into a new round of development and global expansion in the post-war period. Many commentators regard the turn to market fundamentalism of the late 20th century, and the concomitant rise of financial capitalism, as the outcome of this, and the global financial crisis of 2008–2009 as its end-point. In a new book, Kaletsky [2] outlines what he regards as a new state-centered global system as emerging, focused on the rise of China, which he dubbs Capitalism 4.0.

It is the global impact of industrial capitalism on its natural setting, and its breaching of its natural limits, that is of most concern. The sense that industrial capitalism was outgrowing the planet, and destroying not only its own resource base but also the entire biosphere, was becoming palpable by the first decade of the 21st century, as it became clear that while China had achieved astonishing levels of growth over the previous decades, it was also destroying its own environment at a terrible cost to its own inhabitants and to the world as a whole. Now global warming, due to carbon dioxide build-up from the burning of fossil fuels, is the issue that dominates public debate. Yet with few exceptions, the debate remains locked in a conception of the ‘economy’ that ignores its industrial capitalist characteristics and their effects. Books and reports are published, calling urgently for action and for new policies, e.g. in reducing carbon emissions, but in the absence of changes to the underlying rules and procedures that drive forward the industrial capitalist economy, these remain merely rhetorical. Some exceptions have recently appeared, such as the two books published in 2010 and each entitled ‘Climate Capitalism’, and a new study that calls for a redesign of the institutions of property and ownership to take resources out of the ‘commons’. 1 These are welcome departures, which I build on in this study of the underpinnings that drive growth, expansion and destructiveness of the system we call industrial capitalism. My concern is to sketch how this system may be tamed, or ‘naturalized’ in the sense of bringing it into conformity with its natural limits. Is there a ‘spirit of capitalism’ that is inherently destructive, and will continue to destroy the planet and its resources until, as Weber famously put it, ‘the last ton of fossilized coal is burnt’? While some discuss a concept of ‘natural capital’, we may call this emergent system a form of ‘naturalized capitalism’, and a new study that calls for a redesign of the institutions of property and ownership to take resources out of the ‘commons’. 1 These are welcome departures, which I build on in this study of the underpinnings that drive growth, expansion and destructiveness of the system we call industrial capitalism. My concern is to sketch how this system may be tamed, or ‘naturalized’ in the sense of bringing it into conformity with its natural limits. Is there a ‘spirit of capitalism’ that is inherently destructive, and will continue to destroy the planet and its resources until, as Weber famously put it, ‘the last ton of fossilized coal is burnt’? While some discuss a concept of ‘natural capital’, we may call this emergent system a form of ‘naturalized capitalism’. 2 Whatever we call it, this is clearly the ‘next’ Great Transformation – one which, if it succeeds, will enable global capitalism to co-exist with its natural biospheric limits; and if it fails, it will in all probability mean the end of our industrial civilization.

I choose not to discuss policy issues so much as changes in underlying rules and institutions that could characterize ‘naturalized capitalism’ and enable both producers and consumers to keep within the natural limits laid down by the biosphere. I focus on changes in three sets of markets, which together span the entire industrial capitalist system. Firstly, because energy is so important as the underpinning of the entire industrial edifice, and because the burning of fossil fuels has created such a problem, it is changes in the energy markets bringing about the substitution of renewable energy sources for fossil fuels that are of interest. Utilization of renewable energy sources, where the power has to be ‘won’ through the design and implementation of sophisticated technologies, will lead to an enhanced sense of responsibility and moderation. The shift to renewable energy sources is under way, but it could be accelerated by more potent use of capitalist instruments, such as financial instruments that allow numerous small renewable energy projects to be aggregated. Secondly, it is changes in commodity markets that will drive recirculation of materials, and usher in a Circular Economy where one producer’s wastes become another’s inputs. These changes are being driven by shifts in consumer behavior that are translated into low carbon- and resource-intensive production that is propagated along entire value chains, and by changes in the electronic tagging of commodities traded on the great commodity exchanges. Thirdly it is the finance markets that will develop new targeted investment vehicles, known as Green bonds or climate bonds, which will have the effect of shifting patterns of investment away from projects involving fossil fuels to those with lower resource- and carbon-intensity. It is the interconnections between these trends that will make them self-reinforcing and self-propagating, as the ‘new shoots’ of the green economy grow and connect with each other, through competitive emulation. I argue that this will generate a different kind of growth, intensive rather than extensive, where capitalist operations will generate increasing returns without extending the resource base. This would indeed be a different kind of industrial capitalism.

2. The first Great Transformation

Let us begin with the burning of fossil fuels–since it was the substitution of coal for wood and charcoal in Britain in the 17 and 18th century that was the start of the process of industrialization (and the driver of modernization) and of our

1 See Newell and Paterson [3], Lovins and Cohen [4] for recent accounts which discuss the operating rules of a capitalism geared to keep within its ecological limits, and Barnes [5] for an account of ‘Capitalism 3.0’ by which he means a capitalism with new property rights that place ownership of common resources in trusts. While these proposals are of interest, I see little prospect of their being acted on until there have been the more immediate changes in energy markets, resources and commodity markets an financial markets discussed in this paper. Hamilton [6] provides a sobering assessment of our civilization’s prospects under the impact of climate change. Kaletsky [2] provides an account of what he calls Capitalism 4.0, but he does not include discussion of ecological issues.

2 See Stern [7] and Speth [8] for representative discussions of the limits to present patterns of industrial production. Discussion of the end of industrial civilization or even extinction of the human race has recently been canvassed by authors such as Morgan [9] or Tonn [10].
interference with our planetary ecological niche. It was a fateful move, creating liberation from previous constraints, unheard of growth in productivity and income, and spreading worldwide to lift millions of people out of poverty. But it is now coming up against its ecological limits, and threatens its own resource base as well as the biodiversity that we regard as intrinsic to life on earth.

When people in the west started burning fossil fuels on a fairly large scale (starting in Britain in mid-18th century) there were 160 million inhabitants in Europe (790 million people in the world), Europe grew to 200 million by 1800, then doubled again to 400 million by 1900. This was the first time in world history that a large population could double in size without destroying its own environment. The ‘Malthusian trap’ had acted as a tight constraint on population size in pre-industrial times. Every time that a sizeable group of people had fashioned technical or organizational improvements in productivity, allowing their incomes to rise, so their numbers would also increase – unless there was a clear limit imposed such as the civil boundaries of a city. The increasing numbers increased pressure on resources – particularly land for food and forests for fuel – and this in turn checked the continued rise in population. This was the basic insight of Thomas Malthus in his 1798 treatise An Essay on the Principle of Population [11] – and it was the first correct interpretation of the way that the world had worked up to his time. But industrialization was changing the world even as Malthus was writing about it; it turned out that his description fitted the pre-industrial world almost exactly, but not the industrial world with its astonishing increases in resources made available by tapping into fossil fuels.

But what happened next in Britain defied this usual story; there was a breakout from the Malthusian trap. In the mid-19th century, incomes started to rise—and kept on rising. This is linked to the superior productivity achieved by British producers, which in turn was linked to the introduction of capital-saving innovations combined with a shift to fossil fuels – meaning coal.

Fossil fuels, particularly coal, were known in several places, including in China in the period of the Sung dynasty when an industrial revolution came close to being started. But it was only in Britain that a combination of high wages – driven by overseas trade – and low energy costs (low coal prices compared with high fuel wood prices (due to deforestation), led merchants and then industrialists to introduce coal as a substitute for wood and charcoal (or for peat, as in The Netherlands). Switching from organic energy sources to fossil fuel sources, starting with coal, created a vast ‘subterranean forest’ (in Sieferle’s memorable phrase) of fuel reserves. The intensive innovation involved in finding ways to utilize coal in place of wood or charcoal in one industrial sector after another (salt production, glass, then iron, in the form of iron puddling perfected by Henry Cort) provided the foundations of the industrial revolution, with the real breakthrough provided by the Newcomen steam engine for pumping water from coal mines, later perfected as the Boulton & Watt steam engine. These technological innovations were a powerful lever of change (Thomas [16]).

The elements of capitalism had even deeper historical roots, going back to the Chinese and Islamic world business empires of the 11th to 14th centuries, and the transfer of many of their techniques (such as book-keeping) to small city states in Italy, north German provinces and The Netherlands (Venice, Florence Genoa, Bremen, Hamburg, Antwerp, Amsterdam) through the 13th to the 16th centuries. These institutional innovations included a monetary economy, free labor (wages), manufacturing industry, banks, stock exchanges, bills of exchange, insurance and ultimately the joint stock corporation. The nation states of Europe were slower to latch on to these social and economic innovations, but they started to do so in Britain and France in the 16th and increasingly in the 17th centuries, ahead of Spain and Portugal where the Catholic Inquisition and periodic expulsions created terror and social upheaval that disrupted economic development. The center of gravity started to shift to the new nation states, and in particular to Britain with its constitutional monarchy as opposed to the absolutism of France.

Once Britain had found the formula, bringing together capitalist institutions and rules, together with fossil fuels and access to overseas resources, it entered a period of unprecedented expansion in industrial output, which fed a growing domestic population and overseas markets, increases in productivity, and the improvements in per capita income that we associate with the Industrial Revolution. The same combination was rapidly replicated in places where coal deposits were readily available – particularly in the Ruhr valley in Europe (Belgium; German states) and, after the 1830s, with the opening of the Pennsylvania coalfields, in the US, leading these countries to rapidly catch up with the early leader, Britain.

The kind of capitalism that quickly took over the world was an expansionist, acquisitive and ruthlessly rational kind of economic system, one that had been in its totality quite unknown in previous epochs. It employed rational calculation in place of moral or community values and practices. It regarded nature as an objectified entity to be plundered at will (and likewise regarded nature as a limitless sink where waste could be disposed). It sought to turn existing products and practices, with their community links and associations, into commodities that could be bought and sold – starting with manufactured

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3 On the ‘great divergence’ between China and Europe, see Pomeranz [12]. The most recent and authoritative account of the Industrial Revolution of the late 18th century, and why it occurred in Britain, see Allen [13] and for a contrasting view, Clark [14].

4 Sieferle [15] provides an illuminating account of the struggle by industrial entrepreneurs to find ways to substitute for wood or charcoal by coal in Britain in the 17th century, in advance of the later series of famous innovations such as the Boulton & Watt steam engine or the power loom.

5 On the Eastern origins of many of the innovations made in the West, where it was the openness of European societies that enabled them to take advantage of these innovations, see for example Hobson [17]. The rise and fall of these great powers is vividly described by Kennedy [18].

6 Smil [19] provides an authoritative account of the significance that energy has played in world history.

7 The German sociologists/economic historians Max Weber and Werner Sombart, writing at the turn of the 19th/20th centuries, have provided the most penetrating critique of the rationalist underpinnings of capitalism; see Parsons [20] for a sympathetic and clear account of their contributions.
products, then encompassing services such as insurance, freight handling, stock jobbing, and extending eventually to health and education. And it regarded labor as likewise a commodity to be bought and sold, in extreme cases in the form of slavery and child labor. Above all it recognized no limits to its expansion, given its access to fossil fuels and the cornucopia they generated. For all its faults, this was an incredibly successful system that liberated those who enjoyed its benefits from manual labor, from famine, and from what Marx called the ‘idiocy of rural life.’ It effected what Polanyi [1] called, with good reason, the Great Transformation.

Contemporaries at the time of the Industrial Revolution saw it as a liberation from drudgery and, from localism – although the shift to coal as fuel in Britain was everywhere resisted, and succeeded only through its economic (cost) superiority. There were of course romantic opponents, who castigated the ‘dark satanic mills’ for reasons that are entirely understandable (they were, after all, dark and satanic), but they missed the bigger picture by focusing on the details. It now becomes clearer as industrialization spreads its influence worldwide, and more and more parts of the world take up its dynamic (the latest being China) that the romantic critique carries little weight when set against the advantages of becoming integrated into a world industrial system, with the benefits of industrialization/modernization being felt as liberation from obscurantism, from poverty, and from age-old injustices and superstitions (a caste system in one country, the subjection of women to their menfolk in another). The issue is: can these benefits be separated from the destructiveness of the ruthlessly rational, acquisitive and expansionist war launched against a country’s and the world’s resource base (its biosphere) as that country takes its place in the capitalist world order?

3. Ecological impact of industrial capitalism

Successful as this system has been, it has to come up against limits, and these were starting to be felt with alarming severity in the first decade of the 21st century. The market for fossil fuel energy was coming up against ‘peak’ issues as reserves were declining and competition for remaining resources grew more intense.8 The market for resources was becoming more competitive and contested, and the impact of their extraction, throughput and dumping was starting to put enormous strains on the capacity of the system, particularly in China.9 The whole system was starting to look unsustainable, threatening its own resource base and the biodiversity of the planet.

An article published in Nature in 2009 revealed that our industrial civilization was approaching its limits, and was actually breaching these limits (the safe ‘operating space’ for humanity), in the words of Rockström et al. [25]. Herman Daly, considered the father of ecological economics with his insistence over the years that a ‘steady state’ economy is needed, has talked most recently of the world now being ‘full’; our industrial capitalist system has expanded to the point where there are no frontiers left. It now has to come to terms with the limits imposed by a finite planet [26].

A Dutch chemist, the Nobel laureate Paul Crutzen, has coined a graphic term to indicate our impact on the natural world. We are now living, he says, in a new geological epoch—the Anthropocene. By this he means that our industrial civilization now exerts so much influence on the planet’s geology and biology that it deserves the doubtful honor of this terminological innovation.10

So severe have the environmental impacts become that we can now document the ‘global footprint’ of industrial capitalism, in terms of resource and material flows, or (or as done by the Wuppertal Institute in Germany) in terms of the land-equivalent of the resource use by global industrial capitalism. According to these calculations, humanity exceeded its global carrying capacity in 1980, and its ‘global footprint’ to biocapacity ratio has been increasing relentlessly, with the situation deteriorating markedly in the 21st century, under the impact of the industrialization of China and India. By 2030, at the rate we are going, our industrial civilization will need the capacity of two planets to absorb its carbon dioxide and other wastes and provide for continued mining and exploitation of resources.11 Since this is not feasible, ‘resource wars’ must become more common – in the absence of any change to ‘Business as Usual’.

The typical pattern of resource use that has been prevalent since industrialization, when vast new scale was added to traditional patterns of behavior like hunting and fishing and mining, has been overshoot and collapse. The issue of growth vs. sustainability has dominated public debate on the future of industrial civilization, ever since the report to the Club of Rome, Limits to Growth, was published in 1972—sparking furious debate, and turning it into the founding document for the modern environmental and ecological movement [29]. The two sides to the debate have largely talked past each other. There are on the one hand, what Friederichs [30] calls the Cornucopians, with a vision of endless growth fuelled by the power of economic substitution and price-driven choices; and on the other the neo-Malthusians, with a strong sense of the reality of finite stocks of resources which at some point must induce collapse if endless extensive growth is allowed to proceed. How then to

8 On the peaking of oil supplies, see Deffeyes [21] for a clear introduction; and Aleklett et al [22] Höök et al [23] for a revealing examination of fossil fuel trajectories carried in the IEA 2008 and IPCC reports.

9 Economy [24] provides a vivid description of the terrible environmental toll taken by China’s breakneck industrial growth.

10 In the words of Crutzen [27]: “For the past three centuries, the effects of humans on the global environment have escalated. Because of these anthropogenic emissions of carbon dioxide, global climate may depart significantly from natural behavior for many millennia to come. It seems appropriate to assign the term ‘Anthropocene’ to the present, in many ways human-dominated, geological epoch, supplementing the Holocene—the warm period of the past 10–12 millennia. The Anthropocene could be said to have started in the latter part of the eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane. This date also happens to coincide with James Watt’s design of the steam engine in 1784” (p. 23).

11 According to the Living Planet Report 2010, the global footprint to biocapacity ratio has been worsening since 1961, when the ratio was 0.63, to 0.73 in 1965, 0.88 in 1970, 0.97 in 1975, 1.06 (i.e. exceeding biocapacity) in 1980, 1.07 in 1985, 1.18 in 1990, and 1.24 in 1995 [28].

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maintain the prospects for growth, since growth is linked to economic dynamics and innovation, without overshooting the carrying capacity of the biosphere. As Randers [31] put it: “This debate [over whether it is possible to have unending growth in GDP on a finite Earth] has continued till today, in spite of its obvious and simple answer: Economic growth can continue forever, but only if the ecological footprint of that economic activity can be accommodated within the boundaries of the finite physical world. For growth to continue, the ecological footprint per unit of GDP must decrease so fast that the total ecological footprint remains constant (or declines). Only then can unending economic growth be environmentally sustainable.” (2008: p. 854) This is as clear a statement as any on the issue, which is the choice between intensive vs. extensive growth as an expression of the spirit of capitalism.

This is the situation we face now, as the process of globalization of industrial capitalism continues, but with increasing resource toll and diminishing prospects for longevity in its current wasteful form. This is ‘Business as Usual’. It is not capitalism itself that is the problem, but the industrial scale of the form of capitalism that has taken over the world, exhausting fisheries, industrializing agriculture and livestock as commodity production, denuding forests, and expanding cities over the face of the planet. The pollution problems have moved from being local and regional to global, led by the global warming that is now linked, incontrovertibly, with the burning of fossil fuels. The wanton discarding of products, together with the materials from which they are made, is creating uncontrollable landfill problems. The financial bubbles generated by ever more creative innovation in financial instruments have taken their toll of investment in productive activity.

This is not a counsel of despair, merely a realistic appraisal of where we have come with ‘Business as Usual’ pathways. But all is not lost. Just as the seeds of the new industrial capitalist system could be found in small, isolated developments in Europe in the years preceding the 18th century, so the seeds of a new and more sustainable industrial capitalism may be found now – particularly in China, India and Brazil where the need for them is greatest. These new developments can be expected to propagate rapidly, driven by capitalist competitive dynamics. What then will be the features of this new ‘green economy’?

4. The emerging green economy

The ‘new shoots’ of a green economy are emerging within the present fossil-fuelled industrial system. These new shoots can be detected across the entire economy, encompassing energy, resources and commodities and finance.

First, in the market for energy, old and new technologies based on harvesting renewable sources (solar, wind, hydro) are emerging, as well as micro versions of nuclear that promise power without the danger of the earlier nuclear systems. These new systems are being facilitated by investments in smart grids that enable fluctuating sources to be matched across the grid, and by new energy storage technologies (such as molten salt systems in concentrated solar power stations) that overcome problems of intermittency. The capitalist spirit here is harnessed to invest in these new energy sources in the pursuit of profit, driving down the costs through the experience curve, and on the basis of finance that is becoming cheaper as the energy security of such investments becomes more attractive than fossil fuel investments. China is rapidly taking a leading position in all aspects of these new energy sources, driven by its extreme need, extreme pollution problems and exuberant capitalist spirit, and is building export markets for its renewable energy systems around the world. Through the magic of logistic industrial dynamics, the more that Chinese renewable energy industries build momentum, the more certain becomes their eventual supersession of the current energy system. When we add in China’s planning system that directs finance towards favored investment, it could well have an energy system based on hydro, renewable and nuclear that becomes their eventual supersession of the current energy system. The capitalist spirit here is harnessed to invest in these new energy sources in the pursuit of profit, driving down the costs through the experience curve, and on the basis of finance that is becoming cheaper as the energy security of such investments becomes more attractive than fossil fuel investments. China is rapidly taking a leading position in all aspects of these new energy sources, driven by its extreme need, extreme pollution problems and exuberant capitalist spirit, and is building export markets for its renewable energy systems around the world. Through the magic of logistic industrial dynamics, the more that Chinese renewable energy industries build momentum, the more certain becomes their eventual supersession of the current energy system. When we add in China’s planning system that directs finance towards favored investment, it could well have an energy system based on hydro, renewable and nuclear that generates more electric power than fossil fuels by 2030, and eclipses fossil fuels as primary energy source by 2050.

It is capitalist emulation and drive for profits that will accelerate the uptake of renewable energy sources. As they become the dominant energy source, so renewable energies can be expected to exert a profound effect on the ‘spirit of capitalism’. As opposed to the case of fossil fuels, which are regarded as effectively infinite – a form of cornucopia (even when the technology for extracting them becomes highly complex, as in deep water oil drilling) – the winning of industrial power from renewable sources will always be regarded as the fruit of human ingenuity, not natural endowments. The renewable sources themselves are abundant, but the power won from their utilization is wrested using sophisticated technology. Power that is ‘won’ in this way will be measured, and husbanded, and conserved rather than wasted. It could indeed lead to a new international order based not on who happens to have abundance of resources in the ground but on who develops the most sophisticated technology for harvesting renewable energy sources that are available to all.

From the perspective of 2050, when the shift to renewables will be well under way and acquiring unstoppable momentum, the idea that we could mortgage the future of our industrial civilization to a finite resource whose exploitation made countries the pawns of those endowed by chance with supplies, and encouraged brutal dictatorships to protect it, and whose burning was effectively poisoning the planet – such an idea will appear preposterous.

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12 On China’s build-up of momentum in renewable energy industries, see for example Martinot [32], while Lin et al. [33] document the impact that these renewable energies are having on China’s carbon emissions. Urban et al. [34] capture the role that renewable energies and low-carbon technologies are playing in China’s modernization.

13 The logistic function describes the familiar S-shaped curve which best captures the process of substitution of one industrial technology by another, and one product by another; see Fisher and Pry [35] for an early exposition.

14 China’s successful development of renewable energy industries as alternatives to fossil fuel systems is the best response to critics of the feasibility of renewable energies such as Ausubel [36]. On global prospects for renewables such as wind, water and solar, see Jacobson and Delucchi [37].
Second, in the market for resources, a new emphasis on recirculation is emerging rather than the linear throughput of the expansive, wasteful system that dominates now. This new market is driven by firms looking to promote their ‘green’ credentials, by purchasing inputs that are reused, or used less (more efficiently) or are recirculated, and thereby creating value chains that span the economy and propagate the new eco-calculations. At the source of the resource flows, commodities markets themselves are actively weighing prospects for launching ‘eco-futures contracts’ for commodities, adding an eco-identifier to the list of technical attributes that are needed for buying and selling futures contracts.\(^{15}\) Competition between exchanges to launch such ‘eco-futures contracts’ for commodities, and by firms looking to supply themselves with green sources that embody some elements of reduced resource impact, will be expected to drive this process. Again China provides the test case, where the model of a ‘Circular Economy’ has already been adopted as a national development strategy, in face of increasingly severe problems of resource access and waste dumping;\(^{16}\) but Germany and Japan are also well on the way to becoming economies where recirculation becomes the dominant paradigm. The smart firms can see that this is where profits are to be found, and are driving the pace of the transition.

Recirculation of resources will be enhanced as products themselves come to acquire IT-linked tags that describe their full life cycle history, including their provenance and the history of each of the materials involved in the production. Moves are already being taken in this direction, through tagging of products with radiofrequency barcode identifiers (RFID) and developments such as the ‘Internet of Things’ that will bring intelligence and traceability into the very core of the world’s manufacturing system. Products will become individualized and traceable, just like websites today. It is notable that China has already identified the ‘Internet of Things’ as a goal to be achieved within the next five years, under its 12th Five Year Plan\(^{40}\).

It is consumer pressure that is driving the search for new ways to tag products with the history of their constituent materials, to recirculate resources and make production less resource-intensive. This pressure is translated into efforts by producers to advertise their resource-conserving practices, and to deal only with suppliers who do likewise, thereby creating value chains that will propagate themselves throughout the economy, culminating in the commodity markets themselves where fresh initiatives such as electronic tagging of futures contracts can make their own contribution. In this way bottom-up and top-down pressures will create a new sensibility and public awareness of the origins of resources and enhance the value of products containing recirculated resources and materials. Again from the perspective of 2050, when this process will be well advanced, the idea that the origin of resources could be ignored, and commodities could be produced and traded in a ‘generic’ form without regard to their origins, will be regarded as benighted. Capitalist acquisitiveness can continue at the level of the individual corporation (under the slogan ‘freedom of contract’), but at the level of the system as a whole, profound new constraints will ensure that insatiability is replaced by a new emphasis on satiation, through recirculation of resources.

In addition to the markets for energy, resources and products, the market for finance (capital) is also being transformed, in small steps now but in ways that promise to become dominant in the near future. Increasingly large investors (e.g. pension funds) in securities such as bonds are looking to guarantee the security of their investments by placing them in projects that do not suffer from projected resource or fossil fuel shortages. In this way they are becoming much more interested in ‘green’ investments that promise greater long-term security, and the financial instruments targeted at such investment projects (such as ‘green bonds’ or ‘climate bonds’). As the demand for these ‘green’ investment vehicles grows, so their price in terms of interest rates will fall relative to those of financial instruments targeted more generically at any project, without discrimination. In this way a new market for ‘eco-securities’ is being created, to finance investment in specifically ‘green’ and low-carbon projects where the energy and resource security is higher.\(^{17}\)

Banks and other financial institutions will in future be looking for ways to ensure that the finance they generate be targeted and labelled as ‘green’ as opposed to the generic bonds and securities issued now which can be used for any purpose. Thus the criterion of ‘creditworthiness’ will be joined by a second (and more important) criterion of ‘eco-worthiness’ that will attach to the projects to be financed, rather than to the issuer of the bonds or other financial instruments. Green bonds will play an important role in aggregating various small-scale renewable energy and recycling projects, thus giving them the advantage of economies of scale and further reducing the costs of investing in such projects. In these ways, investing in the green economy will come to be far more attractive than investing in the old fossil fuel economy.

These three developments promise to transform the rules by which the expansive, resource-wasting and insatiable industrial capitalist system operates. Individually, and as a group, they will favor the emergence of new markets and new processes that re-embed the economic system in its ecological setting. They promise to generate an economy of sustainable enterprise, one that contributes to, and draws from, the resilience of its ecological matrix.\(^{18}\) It will be an economy that best withstands the tendency to overshoot and collapse to which the current system is all too susceptible\(^{31}\). This is not utopian fantasizing, but a realistic appraisal of the business trends that are already under way.

It is the connections between these tendencies that integrate them into a new kind of ‘green economy’ or ‘climate capitalism’ where the desatiation no longer acts to drive the system to resource collapse (where I use this term as shorthand for the destruction of the biosphere). New energy systems no longer based on fossil fuels will directly counter the tendency

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\(^{15}\) For an example of such an electronically tagged futures contract, relevant to biofuels, see the proposal from Mathews\(^{38}\).

\(^{16}\) On determined moves to introduce ‘Circular Economy’ measures across the Chinese economy, see for example Li et al.\(^{39}\).

\(^{17}\) On these eco-securities, here termed climate bonds, see for example Mathews et al.\(^{41}\); on discussions regarding the establishment of a Green Investment Bank in the UK, see Holmes and Mabey\(^{42}\).

\(^{18}\) See Common and Perrings\(^{43}\) for an early and clear exposition of ecological resilience and its link to economics.
to mine ‘infinite’ fossil resources without limit. In place of exploiting the cornucopia of fossil fuels, industry will instead have to ‘win’ energy through the use of complex and sophisticated technology. No one who has seen the component parts of a modern large wind turbine being put together, or walked the array of parabolic mirrors directing sunlight onto a mixture of molten salts in a specially fabricated carrying pipe (in CSP plants) will be under any illusions as to the sophisticated nature of the technology being employed. While the sunlight and the wind are renewable and inexhaustible, every kilowatt of power has to be won through clever use of this technology. Through the application of IT, the generation of energy from renewable resources will be monitored—and what is measured is husbanded, or conserved. Far from the abundance of renewable sources of energy acting to drive insatiable acquisition, it is the technology of renewable energy power generation and the necessity to construct this technology for every kilowatt generated that will set limits to its use and to energy production and consumption.

Within the sphere of commodities, it is the emergence of a circular flow, and the tendency to recirculate resources, that will counteract tendencies to insatiable consumption. The tendency to recirculate will be a response to new institutional structures of incentives, driven in turn by consumer demand. Just to take one example, in the printing and publishing industry, the level of recycling of paper had reached no less than 72% in Europe in 2009 – driven in this case by insistent consumer demand for the recycled product, but at a price and quality of the non-recycled version [44]. If ever ‘consumer sovereignty’ is to mean anything, it must be here.

Likewise the emergence a circular flow economy for resources, as the products made from them embody more and more recirculated materials and resource-efficient processes become economically feasible, will be felt primarily in the renewable energy industries themselves, thus reducing their resource intensity and accelerating their uptake. This too will inculcate a new attitude to resource conservation, making it more profitable to circulate a resource than dump it or mine it, and again creating entrepreneurial possibilities to pursue such projects. The recirculation of resources will propagate from markets for products to upstream resource sectors and then to downstream markets such as building and construction, printing and publishing and other sectors.

These developments will be driven by a finance sector that will place increasing emphasis on identifying and funding green investment projects. The price of investment in ‘green’ projects can be expected to fall, while the price of investment in fossil fuel and resource-wasting projects can be expected to rise – through the operations of the competitive capitalist system and its finance markets, thus again accelerating the trends. Through direct market connections, and through the aggregating effects of financial instruments, the entire economy will be brought within the ambit of new capitalist eco-calculations that bring ecological limits to the center of concern.

Currently interest rates on bonds issued by ‘emerging market’ countries like Brazil tend to be higher than for established markets – the so-called ‘emerging market premium’ that has to be paid on account of defaults on the part of such countries in recent memory. But the situation will almost certainly be reversed before long, as investments in countries like Brazil will come to look safer, for a variety of reasons including contribution to low-carbon economy. And so investments in these developing countries, when financed by ‘green bonds’ will come to look cheaper than investments in fossil fuel energy systems in the advanced (and sclerotic) countries. Green bonds can in this way be expected to play their part in shifting the capitalist system as a whole towards investments in renewable energy, in the circulation of resources and in resource-saving activities – thereby again acting to curb the ‘desatiation’ tendency within fossil-fuelled industrial capitalism or Capitalism 1, 2, 3 or 4.

Governments will no doubt play a role in facilitating this transition, through judicious policies that favor the new activities and penalize those associated with the fossil system. China is likely to take the lead here because it operates a national planning system, and can channel finance towards investments indicated by the Five Year Plans. But as China matures as a capitalist economy, so it can be expected to rely more on the eco-logic of green prices and markets than on central planning. In other jurisdictions, smart government policies at both national and local level will favor the development of resource efficiency, renewable energies and green finance, through combinations of market mandates, eco-taxes, subsidies and feed-in tariffs. The creation of trusts to manage common eco-property resources would also make sense in such a setting.

5. From green economy to green economics

A new set of rules that represent a genuine departure from ‘Business as Usual’ may be viewed as coming into force, and which will provide the setting where new trajectories promising reduced carbon emissions will start to make sense. In this new institutional environment, policies to curb carbon emissions via taxes or cap-and-trade schemes can gain traction, since

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19 Chief amongst these will be the identification and elimination of the ‘hidden’ subsidies provided to fossil fuels; on this, see the estimates of the vast scale of these subsidies by the IEA [45].

20 For a detailed description of such a proposal, see Barnes [5] and his notion of a Capitalism 3.0 as a new operating system for the global economy that brings it into alignment with its eco-limits; his focus is on constructing property rights for the eco-system and preservation of its eco-services, whereas I am here focusing on the more immediate issue of operation of the energy, resources, goods and finance markets. Costanza [46] provides an insightful review.

21 There are of course many sets of proposals for the sorts of policy innovations needed to curb carbon emissions and bring capitalist operations closer to their ecological matrix, but they are generally couched in terms of actions or prohibitions, not changes in rules and institutions; for an excellent recent example, see Randers and Gilding [47].
they will be working with the trend that recognizes the reality and significance of the economy’s ecological limits. Efforts to formulate global strategies for curbing carbon emissions can be expected to make headway once countries wear themselves off fossil fuels and the expansionist, wasteful and insatiable system that they helped to create. Carbon emissions can realistically be tackled with some hope of their being curbed.22

In this way, the industrial capitalism that underpins ‘Business as Usual’ may be seen to be morphing into a new system consciously embedded in its ecological setting, based on harvesting of renewable energy flows, resource recirculation and materials recycling, and financial support for projects that are framed to operate within their eco-limits.

The new ‘green economy’ can be expected to propagate itself through the entire economy via inter-firm linkages and value chains, particularly in clusters and eco-industrial parks. As one firm seeks advantage through claiming a commitment to reducing its carbon footprint, and insists on similar commitments from its suppliers, who in turn will insist on such commitments from their suppliers, so the new green standards will propagate, via competitive emulation. A printing firm, for example, may seek competitive advantage as a ‘low-carbon’ operation, and insist that its paper suppliers adhere to international standards certifying that papers are not sourced from old-growth forests, or certifying that all paper is sourced from recycled materials; and likewise with its suppliers of printing plates, and inks, insisting that they too meet standards of reduced resource impact, that will propagate through the economy. This is what Kaldor was referring to when he used the term ‘circular and cumulative causation’ to characterize the way that a modern sector could be established in a developing economy, for example in a particular region; now we can resort to the same terminology to describe the emergence and propagation of a ‘green sector’ within the modern capitalist economy. Kaldor was at pains to point to the fact that what drove such propagation was the search for increasing returns, which are achieved as more and firms become interconnected.23

The new system that is emerging can be expected to come to fruition first in China and India and then in the rest of the world by mid-21st century (i.e. within the next half-century). It is in China that the principle of a ‘Circular Economy’ has been adopted as a national development goal, emphasizing multiple ‘eco-linkages’ between firms as the wastes of one firm become the inputs for another firm.24 As these linkages propagate, they generate circular flows of resources and materials, in emulation of the great flows of materials through the natural world. In this way the green economy will become more of a biomimetic economy.

The green economy will continue to emphasize growth, but it will be intensive growth, based on increasing returns, rather than extensive growth based on expansion of throughput. It will generate growth in terms of value creation but not in terms of resource and energy throughput.25 Companies will continue to grow, through innovation and entrepreneurial initiative – although not in ways that have the effect of expanding resource use or fossil fuel dependence.

It is the difference between intensive and extensive growth that is fundamental. Growth that is measured in increases in GDP is usually extensive growth, associated with increasing flows of materials and energy through the economic system. This is what clearly cannot continue indefinitely – and which indeed must be curbed as a matter of the highest urgency. But intensive growth is a different matter entirely. This refers to a growth in value without change in the flow of resources, through increasing levels of recirculation. Individual firms, and value chains of firms, will continue to seek out opportunities to generate increasing returns – just as all capitalist firms before them have done. But increasing returns have until recently been ignored in mainstream economic analysis, which to that extent is a clear departure from capitalist reality. Increasing returns were banished from analysis for reasons solely to do with mathematical tractability of the equations governing supply and demand at equilibrium (there is no convergence with increasing returns); but in capitalist reality, as opposed to its neoclassical fictions, the search for increasing returns govern strategy, and in totality they create the possibilities for intensive growth. The firms earning increasing returns propagate through inter-firm connections through the same process of ‘circular and cumulative causation’ as described by Kaldor [49]. These ideas, which have languished at the margins of economics for so long, will come into their own as the debate between intensive and extensive growth grows sharper.26

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22 Allen et al [48] provide a welcome clarification of the urgency of curbing carbon emissions, setting a limit of a trillion tonnes of carbon to be emitted if temperature rises are to be kept below 2°C.

23 As Kaldor [49] p. 340, put it: “To explain why certain regions have become highly industrialised, while others have not we must introduce quite different kinds of considerations – what Myrdal [52] called the principle of ‘circular and cumulative causation’. This is nothing else but the existence of increasing returns to scale – using that term in the broadest sense – in processing activities. These are not just the economies of large-scale production, commonly considered, but the cumulative advantages accruing from the growth of industry itself – the development of skill and know-how; the opportunities for easy communication of ideas and experience; the opportunity of ever-increasing differentiation of processes and of specialisation in human activities. As Allyn Young [54] pointed out in a famous paper, Adam Smith’s principle of the ‘division of labor’ operates through the constant sub-division of industries, the emergence of new kinds of specialized firms, of steadily increasing differentiation – more than through the expansion in the size of the individual plant or the individual firm.”

24 Terminological confusion is possible here. By ‘Circular Economy’ we mean an economy based on circular flows of materials and resources, in conscious imitation of the great cycles (carbon, nitrogen, phosphorus) of the biosphere. This is to be contrasted with the neoclassical economic conception of the ‘Circular Flow’ economy, which is merely a flow of income unconnected to ecological limits. The use of the term ‘circular’ in Circular and Cumulative Causation refers, by contrast, to feedback loops that ‘close the circle’. See Mathews and Tan [50] for a recent account of the emergence of the Circular Economy in China, where it is now embodied in the current (12th) Five Year Plan as a central goal of national development.

25 Here I part company with scholars who oppose capitalist growth in principle, such as Daly and Cobb [51] or Jackson [52]; the issue turns on whether the growth is considered intensive or extensive. I certainly agree that endless (extensive) growth involving ever-rising volumes of energy and materials cannot be sustained in a finite world, and must be curbed before it is too late.

26 See Toner [53] for a comprehensive discussion of ‘circular and cumulative causation’ and why it disappeared from economic analysis.
It was the American economist Allyn Young [54], in his 1928 Address to the British Association, who boldly posed the issue of increasing returns as the central question to be addressed in economic analysis of the modern industrial system. In place of seeing the genesis of increasing returns as a marginal issue, to be dealt with alongside externalities as something quaint and uncommon, Young grasped that the way that mass production industries go about building the market for their products, and on the strength of the expanded market are able to invest in specialized capital equipment, and as the market further expands are able to make use of specialized value chains of intermediate suppliers, sometimes aggregated altogether in industrial clusters – all this he saw as the central issues, to be the focus of analysis. If theory could not shed light on these processes, or simply ignored them, then it was theory without point or purpose. But now there is a point, and an urgent one: it is the use of the Smith–Young–Kaldor framework of increasing returns generated through circular and cumulative causation as the means of propagation of the capitalist green economy within the matrix of the old, fossil fuel economy.

Young insisted that it is not factor questions and supply-side issues that need to be addressed in accounting for increasing returns, but growth of markets, i.e. growth in demand. This demand-side emphasis is a singular characteristic of Young – an emphasis that mainstream economics has ignored at the risk of making itself irrelevant. Young insisted that firms in modern mass-production industries first address the market, and take active steps to build the market prior to making definitive investments in production. The other feature of such firms’ investment behavior, which again did not escape the notice of Young, is their preparedness to sink large sums into investment in large-scale production systems that would be completely unwarranted by the current state of demand. Such investments are made with an eye on growing the market, through cost reduction as fast as possible—and where the cost reductions are based on prior investments in specialized capital equipment provided by specialist suppliers whose existence is made possible by the breadth of the market, as well as in internal efficiencies that are under the firm’s direct control.

Chart 1. Source: [55].
And this is exactly how one may envisage the growth of the green economy within the matrix of the old, fossil fuel economy will proceed. It will be the growth in demand for green products, and the preparedness of capitalist firms to make investments in production systems to meet the anticipated demand, that will enable the ‘green sector’ to outgrow the old, fossil fuel sector. Indeed Kaldor coined the happy expression ‘chain reaction’ for such a process – again in a way that is exactly applicable to the growth of firms within the green economy, multiplying the opportunities for interaction amongst themselves as their interconnections grow.

Thus the green economy will grow and propagate within the ‘womb’ of the fossil fuel economy, through interfirm connections. Small islands will start (as in eco-industrial parks) and they will then make connections with other firms and with each other, always through insistence on reducing resource and carbon intensity in their transactions. In this way the islands will link up to form archipelagos, and eventually come to dominate the entire economy. A vivid illustration would be provided by the ancient game of GO, where the players start with isolated stones and build up structures through interconnections (adjacent stones) and then eventually join them up so that they reinforce each other. (For an illustrative sequence, see Chart 1)

This is exactly the process we see in the formation of eco-industrial parks and their drive to create interconnections with each other, drawing more and more firms into their ambit and measuring their progress in reducing energy- and resource-intensity. Take some examples from China. In the eco-industrial park of Suzhou, there are multiple interconnections forming, with firms sharing some inputs and sharing some outputs, thus reducing overall resource intensity. The park was opened in 1994 as a cooperative development between Singapore and China, and after a rocky start it is now flourishing, having attracted more than 2400 foreign-invested firms, as well as local entrepreneurial firms, in sectors encompassing electronics, semiconductors, biotechnology, IT, biopharmaceutical and health care. The park’s municipal managers deliberately follow a ‘value chain completion’ strategy in attracting new firms, identifying gaps in the existing value chains and seeking to fill them with new firms. Overall the firms in the park are notching up environmental performance standards that are vastly superior to those found in China generally, such as levels of chemical oxygen demand (COD) and sulphur dioxide emissions that are 1/18 and 1/40 of China’s national averages, and its energy consumption levels to only 0.36 tonnes of standard coal equivalent per 10,000 RMB.27 In 2008, Suzhou and its sister industrial park, Suzhou New and Hi-tech Industrial Development Zone, were both recognized as two of the first three approved EIPs in China. And there are many others moving in the same direction in China, such as Tianjin Economic Development Area with its ambitious eco-development plans.28

It would make sense to track the formation and propagation of such ‘green economy’ islands and their interlinkages, with measurement of their superior energy and resource intensity measures. Perhaps a new United Nations agency could be created for this purpose – the UN Green Economy Agency (GEA) – charged with responsibility for tracking the world’s progress in forming, propagating and measuring the green economy.

6. Concluding remarks

In retrospect, we may view the insatiable performance of industrial capitalism as the product of its expansive phase, as it ‘filled’ the earth and occupied every niche. But it cannot be allowed to continue as the ‘operating system’ of an industrial capitalism that has reached the finite limits of the planet, and has no more frontiers to exploit. Something has to be done to change the ‘operating system’ of the global capitalist order, and has to be done quickly. The alternatives of resource wars and climate change on a ruinous scale, that wipes out not only our civilization but a large swathe of the earth’s other inhabitants as well, is unthinkable.

There are powerful barriers standing in the way of the realization of any eco-aware alternative to the current version of what Nolan aptly calls ‘Wild Capitalism’ with its huge appetite for energy and resource throughput [56]. There is firstly the ‘financialization’ of capitalist markets and the short-term greed that guides the speculative activity in this sector, that nearly brought down the entire system in the global financial crisis of 2008-09, and is now spreading (in the absence of effective constraint) to the commodities markets, thereby driving up fuel and food prices worldwide.29 Clearly this process of financialization must be curbed before the markets of capitalism can be brought into ecological alignment. Then there are the powerful vested interests that block every move towards an alternative – at least in the democracies with their parliaments or Congressional bodies that can become prey to sectional interests. There is the endless drive for (extensive) growth, fuelled by fossil fuel interests, corporations themselves as well as the economics profession, which preaches (extensive) growth as if what Nolan aptly calls ‘Wild Capitalism’ with its huge appetite for energy and resource throughput [56]. There is firstly the ‘financialization’ of capitalist markets and the short-term greed that guides the speculative activity in this sector, that nearly brought down the entire system in the global financial crisis of 2008-09, and is now spreading (in the absence of effective constraint) to the commodities markets, thereby driving up fuel and food prices worldwide.29 Clearly this process of financialization must be curbed before the markets of capitalism can be brought into ecological alignment. Then there are the powerful vested interests that block every move towards an alternative – at least in the democracies with their parliaments or Congressional bodies that can become prey to sectional interests. There is the endless drive for (extensive) growth, fuelled by fossil fuel interests, corporations themselves as well as the economics profession, which preaches (extensive) growth as if it were a religion.30 These are all powerful barriers to change.

Scholars and commentators are now coming to see the possibility of a genuine alternative to ‘wild capitalism’ emerging in China and in Asia generally, as the realization grows that the ‘Western’ model of industrial capitalism, based on endless growth in resources, materials and consumption, is actually a fiction, and cannot realistically hold out promise for the rising

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27 See the official Suzhou website: http://www.sipac.gov.cn/english/zhuanji/jg60n/jglntsj/.
28 For a discussion of these developments in China, in the context of eco-industrial initiatives, see Mathews and Tan [50].
29 There is by now an enormous literature on the topic of financialization and its ill-effects – but little effective counter-action. For a review of financialization of the commodities markets, via index-linked investing, see Ghosh [57] and Kaufman [58] for penetrating analyses.
30 On the (relatively recent) origins of economic growth as a goal of national public policy, and its worship by the economics profession, see Stoll [59], while Victor [60,61] provides much-needed econometric evidence that capitalism can function perfectly well without (extensive) growth. Gilding [62] discusses a feasible strategy for taking the world off this treadmill, while Nair [63] emphasizes the role to be played by Asia in defeating consumptionism.
populations of China, India and Brazil and the many countries lining up behind them. These countries, led by China, are starting to move in the direction of resource constraint, reliance on renewable energies and financial market responsibility. Michael Spence, winner of the 2001 Bank of Sweden Prize in Economics (also known as the 'Nobel' prize in economics), calls this the ‘Next Convergence’ (in the sense of China and India closing the gap between the West and the Rest) and describes the new pattern of development as ‘Asia’s new growth model’ [64,65]. I agree with Spence that this turn towards the internalization of sustainability criteria in China’s new pattern of growth is a development of ‘enormous significance’ both for China and the world. China’s current (12th) Five Year Plan could well provide the ‘blue'-print for an emergent green economy.

My argument then is that the world can keep the attractive features of industrial capitalism – its restlessness, its drive for innovation, its entrepreneurship and capacity to sustain individual initiative – while rechanneling the insatiable acquisitiveness of capitalist firms to make them not only less destructive but actually a source of sound systemic behavior – as China appears to be doing in its new pattern of development. The key is to understand the dynamics that are driving change, and to comprehend them as something that adds up to a new totality. We may call what emerges a ‘naturalized’ industrial capitalist economy, by contrast with the denaturalized system that grew and expanded for the past two and a half centuries, from 1760 to 2010, and which now threatens our industrial civilization with collapse.

References