CAPITALISM’S ENVIRONMENTAL CRISIS: 
IS TECHNOLOGY THE ANSWER?

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The standard solution offered to the environmental problem in advanced capitalist economies is to shift technology in a more benign direction: toward more energy efficient production, cars that get greater mileage, replacement of fossil fuels with solar power, recycling of resources, etc. Other environmental reforms are often advocated as well, such as reductions in population growth and even cuts in consumption. But the magic bullet of technology is by far the favorite, seeming to hold out the possibility of savings in throughput of raw materials and energy, providing for environmental improvement with the least effect on the smooth working of the capitalist machine. The Kyoto Protocol on global warming has reinforced this attitude, leading many environmental advocates in the U.S., and even Al Gore in his presidential campaign, to advocate technological improvement in energy efficiency as the main way out of the environmental mess.

There are two ways in which technological improvements can serve to lower environmental impact. First, by reducing the throughput of materials/energy per unit of output. Second, by substituting less harmful for more harmful technology. Coal, for example, is usually seems as a more dirty fuel than petroleum. Much of the improvement in the quality of the air including the aesthetics, since the nineteenth century, resulted from the reduction in sulfur emissions for which coal is particularly notorious. Solar energy, in contrast to other practical sources of energy, is not only available in inexhaustible supplies (though limited in supply at any given time and place), but is also benign--so in this case the issue of throughput, applicable to most other sources of energy, scarcely enters in. A shift to solar energy is therefore preferred by environmentalists.

These considerations have generated the view that all stops should be pulled out on promoting technological changes that increase efficiency, particularly of energy, and utilize more benign productive processes that get rid of the worst pollutants.

I want to concentrate principally here on the energy efficiency part of this. The problem of the throughput of materials, and the technology of production as a whole, beyond mere improvements in energy efficiency, is a much more difficult problem under the current regime of production. One of the reasons for this is that current productive processes often involve toxins of the worst kind imaginable. For example, we know that the proliferation of synthetic chemicals, many of which are extraordinarily harmful--carcinogenic, teratogenic and mutagenic--is associated with the growth of the petrochemical industry and plastics in particular. This was the central message of Barry Commoner’s Closing Circle. Attempts to overcome this create a degree of resistance from the vested interests of the capitalist order that only a revolutionary movement could overcome. Straightforward improvements in the efficiency of energy use, however, have always been emphasized by capital itself, and fall theoretically within the domain of what the system is said to be able to accomplish--and even what it prides
itself.

In the past it was common for environmentalists to compare the problems of the “three worlds” using the well-known environmental impact or “PAT formula” (Population x Affluence x Technology = Environmental Impact). The third world’s environmental problems, according to this dominant perspective, could be seen as arising first and foremost from population growth rather than technology or affluence (given the low level of industrialization). The environmental problems of the Soviet bloc were seen as due to its inferior technology, which resulted in greater throughput of materials and energy per unit of output, and in less environmentally benign technology in general than in the West. The West’s chief environmental problem, in contrast, was attributed neither to its population growth nor its technology (areas in which it had comparative environmental advantages), but to its affluence. Here the ace in the hole for the wealthy capitalist countries was always seen to be the technological prowess of these economies—which would allow them to promote environmental improvements while also expanding affluence (that is growth of capital and consumption).

What chances then are there for solving, or slowing down, the problem of environmental degradation through new or newly applied technology—compensating (or more than compensating) for the contribution of economic expansion to the ecological crisis?

In order to answer this question it is useful to look at what ecological economists call the “Jevons Paradox.” William Stanley Jevons (1835-1882) is best known as a British economist who was one of the pioneers of contemporary neoclassical economic analysis, with its subjective value theory rooted in marginal utility. Jevons first achieved national fame, however, for his work The Coal Question (1865). Jevons argued that British industrial growth had relied on cheap coal, and that the increasing cost of coal as deeper seams were mined would generate economic stagnation. Substituting coal for corn, within the general Malthusian argument, he observed: “Our subsistence no longer depends upon our produce of corn. The momentous repeal of the Corn Laws throws us from corn upon coal” (The Coal Question, 3rd edition, pp. 194-95). Jevons argued that neither technology nor substitutability (that is, the substitution of other energy sources for coal) could alter this.

Jevons was fabulously wrong in his calculations. His main mistake was to underestimate the importance of coal substitutes such as petroleum and hydroelectric power. Commenting on Jevons’ argument in 1936 Keynes said it was “over-strained and exaggerated” (Essays in Biography, 1951).

But there is one aspect of Jevons’ argument that has attracted the admiration of ecological economists. Chapter Seven of The Coal Question was entitled “Of the Economy of Fuel.” Here he argued that increased efficiency in using a natural resource, such as coal, only resulted in increased demand for that resource, not a reduction in demand. This was because such improvement in efficiency led to a rising scale of production. “It is wholly a confusion of ideas,” Jevons wrote,

to suppose that the economic use of fuel is equivalent to a diminished consumption. The contrary is the truth. As a rule, the new modes of economy will lead to an increase of consumption according to a principle recognized in many parallel instances....The same principles apply, with even greater force and distinctiveness to the use of such a general

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agent as coal. It is the very economy of its use which leads to its extensive consumption.... Nor is it difficult to see how this paradox arises.... If the quantity of coal used in a blast-furnace, for instance, be diminished in comparison with the yield, the profits of the trade will increase, new capital will be attracted, the price of pig-iron will fall, but the demand for it increase; and eventually the greater number of furnaces will more than make up for the diminished consumption of each. And if such is always the result within a single branch, it must be remembered that the progress of any branch of manufacture excites a new activity in most other branches and leads indirectly, if not directly, to increased inroads upon our seams of coal.... Civilization says Baron Liebig, is the economy of power, and our power is coal. It is the very economy of our use of coal that makes our industry what it is; and the more we render it efficient and economical, the more will our industry thrive, and our works of civilisation grow (pp. 140-42).

Jevons went on to argue in detail that the whole history of the steam engine was a history of successive economies in its use—and each time this led to further increases in the scale of production and the demand for coal. “Every such improvement of the engine,” he observed, “when effected, does but accelerate anew the consumption of coal. Every branch of manufacture receives a fresh impulse—hand labor is still further replaced by mechanical labor” (pp. 152-53).

The contemporary significance of the Jevons paradox can be seen with respect to the automobile in the United States. The introduction of more energy efficient automobiles in the U.S. in the 1970s did not curtail the demand for fuel, because driving increased and the number of cars on the road soon doubled. Similarly, technological improvements in refrigeration simply led to more and larger refrigerators. The same tendencies are in effect within industry, independent of individual consumption.

Although Jevons is credited deservedly for introducing his paradox, the full force of the problem he raises is not addressed in The Coal Question. The reason is that as one of the early neoclassical economists Jevons had abandoned the focus on class and accumulation that characterized the work of the classical economists. His economic analysis was primarily static equilibrium theory, ill-equipped to deal with dynamic issues of accumulation and growth. Jevons, who in many ways naturalized capitalism, could provide no more convincing explanations for continuously increasing demand than to point to individual behavior and Malthusian demographics.

Here it is important to acknowledge that capitalism is a system that pursues accumulation and growth for its own sake. It is a juggernaut driven by the single-minded need on the part of individuals and groups for ever greater accumulation of capital. “Accumulate, accumulate! That is Moses and the Prophets!”—wrote Marx (Capital, vol. 1, chapter 24, section 3). The only real checks to this process are those generated by mutual competition and impersonal market forces, and, over the longer run, by periodic crises.

To be sure, mainstream economists, since the days of Adam Smith, have claimed that capitalism is a system devoted directly to the pursuit of wealth, but indirectly to the pursuit of human needs. In reality the first goal entirely overrides and transforms the second. Capitalists do not restrict their activities to the production of commodities that satisfy basic human needs, such as food, clothing, shelter and the amenities essential to the reproduction of human beings and society. The production of more and more profits becomes an end in itself, and the types
of goods produced or their ultimate usefulness becomes completely immaterial. The use value of commodities is more and more subordinated to their exchange value. Use values that are devoted to ostentatious consumption, and that are even destructive to human beings and the earth (in the sense of rendering it unusable for human purposes), are manufactured, and the desire for these destructive goods is manufactured along with them—through the force of modern marketing (see Paul M. Sweezy, “Capitalism and the Environment,” Monthly Review, June 1989).

It is this single-minded obsession with capital accumulation that distinguishes capitalism from all other social systems, explaining why it can never stand still. A “stationary capitalism,” as Joseph Schumpeter observed, is a “contradictio in adjecto” (Essays, p. 29). Competition, of the sort that forces upon capital a continual revolutionization of the means of production in order to maintain and enhance profitability, provides the essential motor force behind this drive to accumulate capital. This is what Schumpeter in Capitalism, Socialism and Democracy called capitalism’s tendency toward “creative destruction”: its creation of new and more efficient forms of production and distribution, through innovation, and at the same time its destruction of previous forms of production and distribution. Caught up in this unrelenting process of accumulation and creative destruction, the system runs rough shod over each and every thing that stands in its path: all human and natural requirements that interfere with the accumulation of capital are considered barriers to be overcome.

The exponential growth of capitalism and the increasing throughput of raw materials and energy that goes with it has resulted in a rapidly compounding environmental problem. It is this which lies behind what the Worldwatch Institute in its State of the World 1999 has called “the acceleration of history” -- by which they mean the more rapid transformation of the planetary environment and destruction of ecosystems.

Since there is no way in which the earth’s fundamental capacity to supply the rapidly increasing demands that we are placing on it can increase, the only way in which the problem can be solved is by somehow reducing these demands. There are three ways of conceiving this: (1) stabilization and even reduction of world population, (2) improvements in technology, and (3) more far-reaching socioeconomic transformations. Since most environmentalists agree that population is gradually stabilizing, but that this will not in itself solve the problem (since per capita throughput of materials and energies continues to rise exponentially), the solution invariably focuses on the other two aspects of the problem, and usually on the technological component.

The Kyoto Protocol, which asks that the advanced capitalist countries cut their emissions of greenhouse gases such as carbon dioxide to 5.2 percent below 1990 levels by sometime between 2008 and 2012, has generated enormous resistance among these countries—despite the fact that failure to check the addition of greenhouse gases to the atmosphere would trigger a series of chain reactions, leading to global environmental disaster, within a relatively short span of historical time. The U.S. has not ratified the Protocol, and indeed the chances of ratification were so non-existent that Clinton did not even send it to the Senate for ratification.

Intense negotiations about the level at which carbon dioxide emissions have to be reduced, the allowances to be made for forests ("carbon sinks"), the role of tradable pollution permits that would allow states to comply by buying permits to pollute, and so on, are still taking place.

The main object of the Kyoto Protocol with regard to carbon dioxide and other greenhouse gases is quite clearly to stop the exponential rate of their increase within the atmosphere. A return to 5 percent below the 1990 level of greenhouse gas emissions by 2012, would mean that the tendency for such emissions to increase exponentially, along with expansion in the scale of production, would have received a strong check. At that point the aim would obviously be to try to maintain this level (assuming no attempt is made to reduce it further), so that emissions increased only arithmetically, not exponentially. (Although it should be acknowledged that emissions at 5 percent below 1990 levels would still mean very substantial increases in the total amount of greenhouse gases in the atmosphere.)

This is often treated, as I have noted, as a technological problem, particularly where carbon dioxide emissions are concerned. It is new efficiencies in energy consumption, in gas mileage, etc., which it is hoped will allow us to have the increase in scale of production without any actual worsening of our annual additions of carbon dioxide. In the decade following the OPEC oil crisis of 1973 the advanced capitalist countries as a whole, faced with higher oil prices, lowered their overall energy intensity/GDP ratio by producing smaller cars with better gas mileage, and through other economies in the use of fuel (though as a result of the Jevons Paradox the overall impact of greenhouse gases continued to rise). Once this decade was over, however, cheaper oil prices allowed this ratio to rise once more.

But it would be wrong to see this as a mere technological problem, since the technologies that would allow us to avoid such a rapid build-up of carbon dioxide in the atmosphere have long been there. If we take transport for example, there have long been in existence modern means of transportation, particularly public transit, that would vastly reduce carbon emissions relative to a transport system built around the private automobile, and that would actually be more efficient in terms of the free and rapid movement of people from place to place as well. But the drive to accumulate capital, pushed the advanced capitalist countries down the road of dependence on the automobile, as the most efficient way of generating profits. The growth of the "automobile-industrialization complex," which includes not simply automobiles themselves, but the glass, rubber and steel industries, the petroleum industry, the users of highway for profit (such as trucking firms), the makers of highways, and the real estate interests tied to the urban-suburban structure --constitute the axis around which accumulation in the twentieth century largely occurred (Sweezy, "Cars and Cities," Monthly Review, April 1973).

In Paul Baran and Paul Sweezy's Monopoly Capital, which was heavily influenced by Schumpeter's business cycle theory (in addition to the theories of Marx, Veblen, Keynes and Kalecki) it was argued that as a historical system capitalism has always been dependent on epoch-making innovations. These are the kinds of innovations that alter the entire structure of production, and the geography of production, on a massive scale, and around which the great mass of investment comes to cluster.

For Baran and Sweezy, three epoch-making innovations had come into play in the history of capitalism--the steam engine, the railroad and the automobile. What distinguished the automobile in this respect is that it served as an epoch-making innovation twice--in two stages of automobilization. The first was the expansion of automobile production in the period up through the 1920s, the beginning of the building of highways, etc. The second was the massive
build-up, symbolized by the construction of the interstate highway system, the destruction of the rival forms of public transit, the accelerated rate of suburbanization, etc., that occurred immediately after the Second World War. It is not too much to say that the technology of the automobile resulted in an entire regime of production and consumption, that has underpinned, and still underpins, accumulation in the advanced capitalist states.3

It is this automobile-industrial complex, which is at the heart of our dependence on petroleum today, and which accounts for the largest portion of carbon-dioxide emissions. At the time of the Gulf War with Iraq, President Bush told the population of the U.S. that the purpose of the war was to defend “our way of life.” Everyone in the U.S. knew what this meant: petroleum. Jevons had called coal the “general agent” on which the entire British industrial system depended, and the economical use of (or cheapness) of coal as what allowed industry to thrive. Today petroleum plays a no less dominant role in our industrial system.

When it comes to reductions in carbon dioxide emissions to slow down the rate of global warming the capitalist class is divided. A significant part of capital in the United States is willing to contemplate more efficient technology, not so much through a greatly expanded system of public transport, but rather through cars with greater gas mileage, and perhaps a shift to cars using other, more efficient forms of energy. Efficiency in the use of energy, without changing the structure of production, is a prospect that capital can generally accept, as something that would ultimately spur production, and increase the scale of accumulation (leading to the Jevons Paradox). But a very large and powerful segment of capital in the United States is not willing to accept even this, because greater gas mileage points generally to smaller engines and smaller cars, and the auto producers are today more than ever making the bulk of their profits from the production of large and indeed increasingly larger vehicles--with the growth in the market for sports utility vehicles and minivans. Henry Ford II’s well-known adage that “minicars make mini profits,” still seems to be the governing principle. As for the petroleum interests, their vested interest in promoting demand for oil is obvious. Consequently, there were virtually no votes to ratify the Kyoto Protocol within the U.S. Senate.

The implementation of solar power solutions, which is completely practical at this stage, has meanwhile been blocked by capitalists and their acolytes at every point. Corporations have sought to take over solar power from the grassroots movement, not in order to promote it, but in order to hold it in abeyance. It is of course the most profitable energy sources--of which solar power is certainly not one--which are promoted, not those most beneficial to humanity and the earth. (This story has been told in an important work by Daniel M. Berman and John T. O’Connor called *Who Owns the Sun?*)

None of this should surprise us. Thorstein Veblen, who might, along with Rudolf Hilferding, be considered one of the originators of the theory of monopoly capitalism, emphasized the fact that capitalism, although it promoted a certain narrow kind of bottom line efficiency, nonetheless represented a system of prodigious waste from any rational-planning perspective--such as that of the engineer. He characterized the oil industry as one of “clamorous waste and mishandling” that led inevitably to “Big business and monopoly control” (*Absentee Ownership*, pp. 200-01). For Veblen the whole industrial system under

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monopoly capitalism (or as he called it the system of “absentee ownership”) was permeated by reckless and useless consumption of human and natural resources, associated with the dominance of pecuniary goals over rational production. “The distinction between workmanship and salesmanship,” he observed, “has been progressively blurred...until it will doubtless hold true now that the shop-cost of many articles produced for the market is mainly chargeable to the production of saleable appearances” (Ibid., p. 300). The sales effort had so penetrated into production itself, that the use value criteria for commodities is undermined and transformed by the needs of exchange value in quite radical ways. From this it is a small-step to the Galbraithian “dependence effect”—that what we consume is dependent on the nature of production, rather than vice-versa, as assumed in the “consumer sovereignty” hypothesis of neoclassical economics (Galbraith, The Affluent Society, chapter 11). Control over production, coupled with the force of modern marketing, has given capital the power to manufacture needs along with products. In fact, “product development” in the giant corporation is usually seen as a subdivision of marketing.

Journalists never tire of pointing to the “love of the automobile” in the United States. But such “love” is more often than not a kind of desperation in the face of extremely narrow options. The ways in which cars, roads, public transports systems (often notable by their absence), urban centers, suburbs and malls have been constructed means that people often have virtually no choice but to drive if they are to work and live. Under these circumstances the car (or minivan), which consumers seem to crave, also becomes a kind of prison, made more tolerable (if only barely) by the introduction of cell phones and other gadgets. Meanwhile the social costs pile up. “Capitalism,” as K. William Kapp declared in The Social Costs of Private Enterprise, “must be regarded as an economy of unpaid costs, ‘unpaid’ in so far as a substantial portion of the actual costs of production remain unaccounted for in entrepreneurial outlays; instead they are shifted to, and ultimately borne by, third persons or by the community as a whole” (p. 231).

In such a system it makes no sense to see possibilities for sustainable development as limited to whether or not we can develop more technological efficiency within the current framework of production—as though our entire system of production, with all of its irrationality, waste and exploitation has been “grandfathered” in. Rather our hopes have to be pinned on transforming the system itself. Moreover, this means not simply altering a particular “mode of regulation” of the system, as Marxist regulation theorists say, but in transcending the existing regime of accumulation in its more essential aspects. It is not technology that constitutes the problem, but rather the socioeconomic system itself. The social-productive means for implementing a more sustainable relation to the environment within the context of a developed socioeconomic formation are available, it is the social relations of production that stand in the way.

Any attempt to follow out this contradiction in detail would take me well beyond the confines of the present essay. I will merely say in conclusion, in the words of Paul Sweezy (“Cars and Cities”) that “while I believe certain palliatives to be possible, at least in principle, within the framework of the present monopoly capitalist system, I do not think that fundamental changes in the structure of cities and their relation to society as a whole [or equally large changes within the structure of production and marketing] can be effected without a radical change in the social order.” For Marx, the very nature of capitalist society from the very beginning had been built on a metabolic rift between city and country, human beings and the
earth—a metabolic rift which has now been heightened beyond anything that he could have imagined (see Foster, “Marx’s Theory of Metabolic Rift,” American Journal of Sociology, September 1999). It is in the very irrationality, wastefulness and destructiveness inherent in capitalist society, which has been built up over the past five centuries, that our main hopes (as well as our fears) for the future are to be found. There is an irreversible environmental crisis within global capitalist society. But setting aside capitalism, a sustainable relation to the earth is not beyond reach. To get there we have to change our social relations.

Jevons had no answer to the paradox he raised. Britain could either use up its cheap source of fuel—the coal upon which its industrialization rested—rapidly, or use it up more slowly. In the end, he chose to use it up rapidly: “If we lavishly and boldly push forward in the creation of our riches, both material and intellectual, it is hard to over-estimate the pitch of beneficial influence to which we may attain in the present. But the maintenance of such a position is physically impossible. We have to make the momentous choice between brief but true greatness and longer continued mediocrity” (The Coal Question, pp. 459-60). Put in that way, the direction to be taken was clear: to pursue glory in the present and a drastically degraded position for future generations. Insofar as Jevons’ paradox continues to apply to us today—that is, insofar as technology by itself (given the present framework of production) offers no way out to our environmental dilemmas, which increase with the scale of the economy—we must either adopt Jevons’ conclusion or pursue an alternative that Jevons never discussed and which doubtless never entered his mind: the transformation of the social relations of production in the direction of socialism, a society governed not by the search for profit but by peoples’ genuine needs, and the requirements of socio-ecological sustainability.  

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4 “An energy revolution is both possible and necessary, but it will be achieved only as part of a broader revolution that takes power away from capital and puts it in the hands of the people where it belongs.” Paul M. Sweezy, “The Guilt of Capitalism,” Monthly Review, vol. 49, no. 2 (June 1997), p. 61.