

## **Ecosocialism or Ecocatastrophe**

**(The 2007 Daniel Singer Millennium Prize Submission, August, 2007, revised February 11, 2008)**

**David Schwartzman  
Professor  
Department of Biology  
Howard University  
Washington, DC 20059**

We ought to dream! (Lenin, What is to be Done?)  
Imagine! (John Lennon, song)  
Globalize human happiness! (Nichi Vendola, 2006)

Red green politics is the art and science of making the impossible happen: peace, equality and harmony with nature (this paper)

### **Abstract**

A major breakthrough in socialist theory is necessary in order to move the practical struggle forward, namely its urgent integration with the physical, natural and informational sciences that should inform a sustainable future for humanity. I sketch out some ideas towards meeting this goal. A huge project awaits us, and we don't have much time left.

### **Introduction**

The “practical struggle” opening up a path to a socialist future is now compelled to confront the looming threat of ecocatastrophe from global warming. Confront, meaning a full recognition of the centrality of this challenge with its practice drawing from a truly ecosocialist theoretical foundation. This threat is no longer a potential contingent outcome in some indefinite future of the unsustainable mode of production and consumption of global capital reproduction, but now is highly probable in the near future unless radical changes in both political and physical economies are made in time.

We face an unprecedented bifurcation in humanity's future. Never before has the technological creation of humankind has posed such a global threat. Recognition of the imminence of this threat is very recent, informed from the state of the art understanding of the global climate and anthropogenic greenhouse forcing.

We may have only a decade left to avoid catastrophic climate change (“C3”), which would make the world even more dangerous and miserable than the living hell for hundreds of millions we now experience (1). The film *Children of Men* gave us a chilling glimpse of this future: a fascist regime confining refugees from the global South in

concentration camps. Massive emigration is precisely the outcome of unchecked global warming from regions especially devastated from the combined effects of global sea level rise and agricultural collapse.

The avoidance of C3 requires the end of oil and fossil fuel addiction, giving up the nuclear option and a rapid conversion to a high efficiency solar energy infrastructure. Since the major obstacle to this path is the nuclear military industrial fossil fuel complex (“MIC” for short), especially its U.S. component, this complex and its imperial agenda must be confronted, isolated, and finally eliminated as the biggest threat to human survival (2). More precisely, its material infrastructure should be solarized, with containment of its huge legacy of chemical and nuclear waste. A solarized and demilitarized world, a formidable challenge to say the least!

But if the global and national peace and justice movements succeed in meeting it, a much more just, peaceful and sustainable society will be created for our world’s children and grandchildren (3).

This outline of two likely and radically different scenarios of just a few decades into the future of the 21<sup>st</sup> century is informed by an analysis of the cutting edge of climate science and the political economy of the present. I contend that the world even as soon as 2020 will not look like a near continuation of the present, rather it will be much worse or much better with respect to the quality of human life. The outcome is contingent on the success of ecosocialist practice and theory.

The Iraq war and occupation has left the U.S. imperial project severely damaged, the only positive outcome of this horrific intervention. A multipolar world replacing the US hyperpower is necessary but far from sufficient to open up an ecosocialist path for humanity. An ecosocialist transnational has yet to emerge with the necessary power to prevent a plunge into a world of ever magnified destructive power to both humans and nature.

Not only must socialist practice be red and green, but its successful fulfillment is critically contingent on the development of a robust theory. One critical theoretical challenge is achieving a deep understanding of the dialectics of social governance of production and consumption from the global to the local level. Expanding the commons in all spheres of social life is imperative, likewise self-management at all levels from global to local. However, even in a radically democratized world local autonomy must be limited by the character of its global impacts (4). Another critical challenge is the theorization of the necessary conditions for creation of a transnational ecosocialist movement and its interrelationships with local and national struggles.

But I submit that socialist theory has long lacked a full conceptualization of the technological basis of an ecosocialist transition to a future global society (5). Socialist political economy cannot theorize this transition by itself. The natural, physical and

informational sciences, in particular, climatology, ecology, biogeochemistry, and thermodynamics, must be fully engaged. These sciences will inform the technologies of renewable energy, green production and agroecologies whose infrastructure must replace the present unsustainable mode.

Marx and Engels had prophetic insights into the ecological impacts of capitalist society (6). But there has been little socialist engagement with the physical/natural sciences necessary for a sustainable economy in the late 20<sup>th</sup> Century. The environmental crisis contributed to the collapse of “real existing socialism”, with the notable exception of Cuba, significantly now a leader in agroecology (7). The near absence of ecosocialist theory and practice has left a space for the penetration of neo-Malthusian and “end of growth” ideologies into the contemporary green movement. We are treated to continual invocations of fallacious visions of entropic apocalypse. Instead of scientific utopias we more frequently confront dystopian visions of hell on earth, depicting the only option being a return to a primitive relationship with nature. Harvey Wasserman’s “Solartopia!” is a rare and refreshing exception.

So I urge we proceed in the spirit of Bloch's "warm stream of Marxism", its rescue of utopia by revealing the process by which utopia is possible (Bloch, 1986), using its "cold stream", materialist analysis and the cutting edge of science and knowledge of the technology of the possible. We should “unashamedly embrace utopia” (Geras, 2000), but a concrete utopia in its full materiality, recognizing that its contours will be fleshed out by struggle and dialogue.

### **The misuse of entropy in social prognostication, why the ecosocialist project should rest on robust thermodynamic theory**

I start with a brief look at the common misuse of the thermodynamic concept of entropy in recent discussions of sustainability and energy use (8).

Peak Oil apocalypse-enthusiasts and neo-Malthusians commonly draw from the thermodynamic theories of Nicholas Georgescu-Roegen, a founder of ecological economics. They have argued that global energy use must be drastically reduced as the existing mode is replaced or runs out, claiming that there are entropy limitations blocking the possibility of a global high efficiency solarized economy. However, a major fallacy in Georgescu-Roegen's so-called 4<sup>th</sup> Law of thermodynamics was his conflation of isolated and closed systems. He claimed “ A closed system (i.e., a system that cannot exchange matter with the environment) cannot perform work indefinitely at a constant rate” (Georgescu-Roegen,1989). If this system is also isolated to incoming high quality energy (a low entropy flux) then this conclusion is correct (a mere restatement of the 2<sup>nd</sup> law of thermodynamics). Hence for an economy run on fossil fuel energy, or even the fission of uranium or thorium, all with finite reserves in the earth’s crust, this economy will eventually run down, since the energy to do work is not renewable, i.e., you cannot reuse waste heat ad infinitum (true of waste heat from using solar energy as well) nor can you regenerate the low entropy energy reserve (with solar energy the sun

does this for you!).

However, while the biosphere is essentially closed to transfer of matter, it is not isolated with respect to energy flux, in particular, solar radiation. Presently the global anthropogenic energy flux is equal to 0.03% of the solar flux to land. Hence tapping the solar flux has huge potential as the energy basis of future civilization, with much smaller impacts on global ecology than now, any such conversion to useful work results in essentially no added waste heat to the environment above the natural flux. Georgescu-Roegen's conflation of the thermodynamic concepts of closed with isolated apparently was the root of his contention that solar energy would always be parasitic on a fossil fuel base, and this pessimism has continued to inspire many neo-Malthusians and even Marxists who should know better (Schwartzman, 1996, 2008).

And yes, increasing energy conservation is imperative, especially in energy wasteful countries like the U.S. but the potential energy from a global solarized civilization can significantly exceed the present energy consumption level without most of its negative impacts.

Several prominent and influential Marxist scholars have recently drawn from Georgescu-Roegen's theory of entropy. Joel Kovel's (2002) appropriation was critiqued in Boucher et al. (2003). More recently, Paul Burkett (2005, 2006) supported Georgescu-Roegen's theory of entropy in an apparent attempt to seek convergence of Marxist theory with ecological economics. The very shaky foundations of Georgescu-Roegen's thermodynamic theory, however, undermine this attempt (Schwartzman, in press). Likewise, Altvater (2007) makes a similar reference to Georgescu-Roegen's theory of entropy, quoting him with approval: "it is not the sun's finite stock of energy that sets a limit to how long the human species may survive. Instead, it is the meager stock of the earth's resources that constitutes the crucial scarcity" (Georgescu-Roegen, 1971). However, this contention is inaccurate because recycling and recovery of metals and other matter derived from these resources can continue in the far future utilizing the incoming solar flux (Schwartzman, 2008). Altvater does conclude with a positive argument for a solar revolution with the potential of ending the dependence on fossil fuels, unlike Georgescu-Roegen who argued that solar energy generation would never escape being a parasite on depletable energy resources.

Further, invoking the threat of Peak Oil is misleading for several reasons. The reserves of heavy oil and tar sands are likely at least as large as the proven reserves of ordinary crude (e.g., Venezuela alone may have a heavy oil reserve roughly equal to the less viscous global crude reserve). Further, global extractable coal reserves would supply the world with energy at the present consumption levels for 600 years, with the U.S. proven reserves some 25% of the global. Considering *only* energy reserves, once the production of ordinary oil peaks, there is plenty to replace it, especially since coal can be converted by the process of liquefaction to oil, in spite of its amplified carbon emission. *But the world cannot afford this energy transition within a fossil fuel regime. Thus, the peak in fossil fuel production and consumption must come as soon as possible, driven by a rapid*

*conversion to renewable energy and more efficient use of energy, rather than the reserves still in the ground.* This conversion is imperative because of the prospect of C3.

In a recent article, Michael Klare (2007), a scholar who has illuminated the issue of resource wars and the U.S. imperial agenda (Klare, 2002, 2004), asserts that “it is apparent that the world faces a profound shift in the global availability of energy, as we move from a situation of relative abundance to one of relative scarcity”. But there is certainly no prospect of real scarcity of energy when the sun supplies in one hour the entire world’s energy consumption in one year.

### **Ecosocialism into solar utopia**

And finally I now sketch out some of the material and technological components that I believe will be essential to an ecosocialist transition.

These I argue include:

- 1) A global high efficiency solar energy infrastructure, replacing fossil fuels and nuclear energy;
- 2) Application of the containment and precautionary principles to environmental policy (including industrial ecology, organic agriculture centered around and in green cities);
- 3) Progressive dematerialization of technology, global availability of state-of-the-art information technology;
- 4) Increase of human population density centered in green cities, elimination of sprawl leaving extensive biospheric reserves, managed to preserve biodiversity.

Radical political and economic changes are, of course, necessary to realize these material prerequisites (Schwartzman, 2005), a challenge that is now a focus of intense investigation and debate by scholars and activists globally. Further, the actual creation of sustainable infrastructures must always be contingent on a process that organically includes participation of both the exploited and oppressed, so that the social management and impacts of these technologies are emancipative.

Joel Kovel’s (2002) argument for ecosocialism makes an eloquent case for ending the rule of global capital. Last fall, an historic meeting in Paris created the embryo of an ecosocialist international (<http://www.ecosocialistnetwork.org/index.htm>).

I think that a global “solar capitalism” is an illusionary prospect because the level of red and green struggle required to solarize global capitalism will likely result in ecosocialist transition. While individual capitalist economies may solarize, the dominant role of the military industrial complex in global capitalist reproduction makes its termination both an essential requirement for and likely a direct path to ecosocialist transition on a global scale.

Is ecosocialist transition to “solar utopia” an achievable goal in this the 21st century, or is

this simply wishful thinking? Aside from the formidable political challenges, are the claimed material prerequisites realizable? Two material prerequisites are arguably paramount: the creation of a solar-based energy infrastructure, and agroecologies sufficient to support the global human population while significantly reducing negative environmental and ecological impacts characterizing fossil-fuel intensive industrial agriculture.

The practicality of creating a global solar infrastructure with even existing technologies in several decades is now plausibly argued (e.g., Scheer, 2007, Nelson, 2007 for the U.S.). Even existing solar technologies, coupled with energy conservation, can be the basis of a high efficiency infrastructure capable of replacing the present unsustainable fossil fuels/nuclear power/big hydropower energy system. These solar technologies include wind and solar thermal power and photovoltaics.

Expansion of nuclear energy, specifically a reincarnation of fission-powered reactors with new technology, will not significantly mitigate global warming (Van Leeuwen, and Smith, 2004), nor will it plausibly avoid the well-known negative environmental and health impacts of this energy source (9).

The energy and material requirements for this transition in energetic infrastructure are considerable but not limited by the available fossil fuel reserves; nor are the negative impacts from this necessary parasitism on the existing energy base significant, relative to the continued reliance on a fossil fuel base. One example is a current plan to create a concentrated solar power infrastructure in the Sahara, which would meet the entire present demand for electricity in Europe and simultaneously provide a large increase in power availability for North Africa, with a radical reduction in carbon emissions, by 2050, at a lower cost per kwh than present market costs for electricity production (10).

Demilitarization will free up vast human and material resources necessary for this transition. If this prospect is unthinkable on the time frame necessary to avoid the likely catastrophes of global warming impacts, then so is any meaningful progress for humanity in this century. Of course a truly equitable implementation of solarization must entail an elimination of North/South disparities and democratic governance. Decentralization of power production (allowing cogeneration of heating) will result in reductions in carbon emissions and improvement of quality of life (11). The creation and maintenance of this solarized infrastructure necessary for green cities would create 21<sup>st</sup> Century employment for oppressed minorities and unemployed around the globe.

And as for the second big challenge, can the global population be fed without the concomitant negative impacts of industrial agriculture? "Overpopulation" is a reality, but only in the context of the carrying capacity of the present political economy in this world of extreme inequalities and not the alleged carrying capacity of the biosphere. Mike Davis eloquently describes the overpopulated cities of the South, bursting with poor residents driven from rural areas (Davis, 2006), resulting from the social impacts of the so-called green revolution (Boucher, 1999) as well as structural adjustment programs imposed by the IMF. But other regions are actually now under populated, such as rural

areas in countries of sub-Saharan Africa, devastated by AIDS, with population size arguably too low to restore and maintain sustainable agricultural production.

“Overpopulation” is not the fundamental driver of global inequalities and widespread misery; it is, rather, a symptom of the unsustainability of this world economy dominated by capital reproduction taking priority over the needs of humanity and nature. Even now there is still enough food produced globally, both in calories and nutritional content, to potentially feed everyone (Boucher, 1999), although this mode of production has huge negative impacts on people and nature. Hunger and malnutrition are the results of existing political economy not any real shortage of food. But can agroecology still feed the world's population without the well-known negative impacts of industrial agriculture? There is a very good case that it can, even in preferred synchronicity with the process of solarization (Badgley et al., 2007; Pimentel et al., 2005; Vasilikiotis, 2005).

### **The End of Value in the 21<sup>st</sup> Century?**

Will Solar utopia realize the End of Value, i.e., capital reproduction (Davis, 2000; Davis et al., 1997; Dyer-Witheford, 1999) ? This passage from Davis (2000) is illuminating: "New technologies express the fulfillment of Marx's writings in his "Fragment on Machines" -- a production system without human labor, where the productivity of technology so overwhelms the production process that "labor time ceases to be the measure" of wealth and "production based upon exchange value collapses." Such a production system is antithetical to a system based on the expropriation of surplus labor, and by definition cancels it. However, production has not collapsed; rather than work disappearing, or at least lightening, more people than ever are engaged in wage labor; and each new high-tech production zone seems to be matched by a new Dickensian production zone. Can these two positions be reconciled? Qualitatively new technologies are labor-replacing technologies, and lay the basis for Value-less production. ... The new technological climate does not in itself destroy the Value system, or capitalism, but it does create the conditions for Capital's destruction and the construction of a communist society. The end of Value is not automatic, but a conscious act by class forces born out of the new conditions." As Davis ends his essay, "This is how Value will end – as a political act, the exercise of class power", i.e., class struggle.

A critical material prerequisite for the end of Value is the availability of virtually "free" energy derived from a global infrastructure of high efficiency capture of solar energy. This infrastructure will create the supply and quality of energy necessary to radically reduce negative environmental impacts, indeed to also restore and repair the biosphere, though irreversible damage has already occurred (e.g., biodiversity loss). In contrast, continued reliance on the present unsustainable energy supply not only contributes to well-known negative environmental, ecological and health impacts, it thereby reduces labor productivity while externalizing the costs of these negative impacts.

We may now be near revolutionary breakthroughs in high efficiency plastic photovoltaics, solar driven hydrogen generation by water-splitting, as well as highly efficient wind-driven electricity production (12). Each stage of history has been energy-

parasitic on the previous: pre-industrial (low efficiency solar, i.e., photosynthesis), then industrial (fossil fuels, nuclear fission) now in the 21st century, the challenge of transition to post-industrial high efficiency solar parasitized by the remaining reserves of fossil fuel energy, particularly natural gas, the preferable choice with respect to limiting carbon dioxide emissions (if pipeline leakage of methane into the atmosphere could be significantly reduced).

Another challenge to ecosocialist theory and practice: develop dynamic models that include explicit assumptions and quantitative parameterization are useful, not as a basis of "scientific" prophecy, but rather to demonstrate the practicability of solar utopia, and a heuristic tools to help think through the contingencies and possibilities entailed in this project to achieve it. Such models may reveal unexpected places in global political economy where ecosocialist movements might have the most leverage, to move the monstrous boulder of capital down the slope to its well-deserved sedimentary cemetery of prehistory on a path that minimizes the destruction of nature and humans.

Specifically, we need models of the transformation of industrial/genetically modified agriculture to global agroecologies, the creation of green cities, and industrial ecologies in a world committed to rapid and progressive demilitarization and solarization, models that begin to demonstrate that another world is indeed not only possible but realizable in the 21st century.

## **Conclusion**

Solar utopia is that "other world possible" when every child born on Earth has the right to a full life of creative fulfillment, to an environment free of hatred and pollution, and to a world with our planet's full complement of biodiversity intact, or at least what is left of it when the present global regime prioritizing capital reproduction over human and nature's needs is ended.

This optimistic, yes, frankly utopian vision of a global civilization will likely be achievable only if we can prevent climate change catastrophe by a timely transition to a global solarized economy. To be a "Leninist" now in our political practice is essential, i.e., to recognize the potentiality of the moment and act, else we lose the chance to change the future (13). But the vision itself and its realization cannot be a result of "expert" dictation, only as a product informed by the dialogue between a committed scientific/technological intelligentsia and communities of struggle, as embryos of the future are created within the womb of globalized capitalism, as global class struggle unfolds to achieve its full reality.



## Footnotes

(1) The case for C3 and its prevention:

[http://environment.independent.co.uk/climate\\_change/article2675747.ece](http://environment.independent.co.uk/climate_change/article2675747.ece)

The Earth today stands in imminent peril [of course it is not the Earth in imminent peril but humanity and biodiversity as we know it].

<http://www.columbia.edu/~jeh1/>

Jim Hansen, June 2007: How Can We Avert Dangerous Climate Change? Revised paper based on testimony, Select Committee on Energy Independence and Global Warming, U.S. House of Representatives, April 26, 2007.

Hansen, a leading climate change scientist (director of NASA's Goddard Institute for Space Studies, New York, now thinks his recent targeted 450 ppm ceiling in the atmospheric carbon dioxide level may be too high to avoid ecocatastrophe, especially from sea level rise from accelerating icecap melting. A now widely supported goal of 80% reduction in carbon emissions by 2050 is likely far from being as “radical as reality itself”.

<http://business.guardian.co.uk/story/0,,1700409,00.html>

Robert Newman, The Guardian, February 2, 2006

“It's capitalism or a habitable planet - you can't have both”

(2) MIC is likely the biggest single obstacle to preventing C3 because most critically the Pentagon is a “global oil-protection service” for the U.S. imperial agenda (Klare, 2007). Further, the military and greater MIC are also huge consumers of oil. Estimates of global military aircraft fuel consumption (1990) translate into about 13% of global oil production (Olivier, 1991), with the U.S. consuming roughly 44% of the total (Bandarge, 1997; she estimated the energy Pentagon uses up annually is sufficient to run the entire US urban mass transit system for almost 14 years). More recent estimates give lower Pentagon consumption levels, only about 0.4% of annual global oil consumption (LMI Government Consulting study cited by Klare, 2007). More research is needed to evaluate not only the Pentagon's direct consumption, but the likely much higher levels of MIC as a whole.

Included in Callinicos' (2003) “transitional programme” is a call for the “dissolution of the military-industrial complex”, along with steps to prevent environmental catastrophe. I argue the former is a necessary condition for the success of the latter. For an enlightening discussion of the huge scale of the U.S. military industrial complex and the significance of expanded military spending see Cypher, 2007.

(3) I proposed solar communism as the name of a future global society that will realize an

updated version of Marx's guiding principle for his vision of communism, namely "From each according to her ability, to each according to her needs", where "her" refers to humans and nature (ecosystems) (Schwartzman, 1996, 1998). I urge the rethinking of the scientific utopian vision of communism, cleansed of the stain of Stalinism and Maoism, fully acknowledging the crimes committed in its name and freed of the dogmas that froze it in ideologies like state-sponsored "Marxism Leninism". This is how the governor of Puglia, Italy, Nichi Vendola, a gay Catholic Refoundation Communist responded to this question: "So what can communism mean in this day and age?" Vendola replied: "The word," he says, "is redolent of light and dark. The dark was the gulags, the tragi-comic dictatorships. But we have to return to the roots and aim for true globalisation: not that of the market but of human rights and the globalisation of human happiness." (<http://news.bbc.co.uk/2/hi/europe/4882180.stm> ).

And why communism and not simply socialism? Following the Leninist tradition, I define socialism as the first phase (stage) of communist society (Marx, 1938), hence the *transition* from capitalism to communism. This transition will surely be hybrid, a process of nonlinear emergence, likely protracted but now an imperative for C3 prevention. I find the equation of (Eco) socialism and communism (e.g., Kovel, 2002, Burkett, 2003) unhelpful because it points away from the necessity of addressing a theory and practice of *transition*, the project of emancipative transformation (Brie, 2005; Brie is associated with the Rosa Luxemburg Foundation, <http://www.rosalux.de/engl/home.htm>).

(4) Gregory Albo, 2007, has lucidly discussed the limitations of an eco-localist approach.

(5) This issue has of course been discussed by socialist scholars, with Wallis, 2007, a notable example, but I simply point out that much more work needs to be done to bring make socialist theory fully ecosocialist.

(6) See Foster, 2000, for valuable insight into Marx's ecological thinking.

(7) See Funes et al., on Cuba's notable experience with agroecological production.

(8) I discuss this subject at length in Schwartzman, 2008.

(9) See e.g., <http://www.citizen.org/cmep/>.

(10) The Trans-Mediterranean Renewable Energy Cooperation (TREC) Project: <http://www.trecers.net/index.html>

(11) see: <http://www.greenpeace.org.uk/climate/solution/revolution.cfm>

(12) <http://www.skywindpower.com/ww/home.htm>

"A Technology Key to Energy Independence and Arresting Global Warming, Wake up, world! Why look down, not up, to meet the world's there is far more than enough energy in high altitude winds, miles above the earth's surface, to supply all the world's power needs."

(13) Not implying a return to the petrified doctrine of “Marxism-Leninism”, but rather to utilizing Lenin’s great legacy to politics; see Budgen et al., 2007.

## References

- Albo, G., 2007, The limits of eco-localism: scale, strategy, socialism. In: *Coming to Terms with Nature, Socialist Register 2007* (L. Panitch and C. Leys, editors), 337-363, Monthly Review Press: New York.
- Altvater, E., 2007, The social and natural environment of fossil capitalism. In: *Coming to Terms with Nature, Socialist Register 2007* (L. Panitch and C. Leys, editors), 37-59, Monthly Review Press: New York.
- Badgley, C., Moghtader, J., Quintero, E., Zakem, E., Chappell, M.J., Aviles-Vázquez, K., Samulon, A., and I. Perfecto, 2007, Organic agriculture and the global food supply. *Renewable Agriculture and Food Systems* 22: 86-108.
- Bandarge, A., 1997, *Women, Population and Global Crisis-A Political-Economic Analysis*. Zed Books: London.
- Bloch, E., 1986, *The Principle of Hope*, Basil Blackwell: London.
- Boucher, D., ed. 1999. *The Paradox of Plenty*, Food First Books: Oakland.
- Boucher, D., Schwartzman, D., Zara, J. and P. Caplan, 2003, Another look at the end of the world. *Capitalism Nature Socialism (CNS)* 14 (3), 123-131.
- Brie, M., 2005, Trying new horizons, (available at: [http://www.redandgreen.org/Documents/David/Trying\\_new\\_horizons.htm](http://www.redandgreen.org/Documents/David/Trying_new_horizons.htm)).
- Budgen, S., Kouvelakis, S. and S. Zizek, S. 2007, *Lenin Reloaded*, Duke University Press: Durham and London.
- Burkett, P., 2003, Ecology and Marx's vision of communism. *Socialism and Democracy* 17 (#34): 41-72.
- Burkett, P., 2005, ‘Entropy in Ecological Economics: A Marxist Intervention’, *Historical Materialism*, 13, 1: 117-52.
- Burkett, P., 2006, *Marxism and Ecological Economics*. Brill: Leiden.
- Callinicos, A., 2003, *An Anti-Capitalist Manifesto*. Polity: Cambridge UK.
- Cypher, J.M., 2007, *From military Keynesianism to global-neoliberal militarism*.

Monthly Review 59, No.2: 37-55.

Davis, J., 2000, The End of Value (paper, Marxism 2000 Conference, Amherst, MA, September): <http://www.gocatgo.com/texts/eov.html>

Davis, J., Hirschl, T. and M. Stack (editors), 1997, Cutting Edge, Verso: London.

Davis, M., 2006, Planet of Slums. Verso: London.

Dyer-Witheford, N., 1999, Cyber-Marx, Cycles and Circuits of Struggle in High Technology Capitalism. University Illinois Press: Urbana.

Foster, J.B., 2000, Marx's Ecology. Monthly Review Press: New York.

Funes, F., Garcia, L., Bourque, M., Perez, N., and P. Rosset, 2002, Sustainable Agriculture and Resistance. Food First Books: Oakland.

Georgescu-Roegen, N., 1971, The Entropy Law and the Economic Process. Harvard University Press: Cambridge.

Georgescu-Roegen, N., 1989. Afterword, In: Rifkin, Jeremy, Entropy. Revised edition. Bantam Books: N.Y.

Geras, N., 2000, Minimum utopia: ten theses. . In: Necessary and Unnecessary Utopias, Socialist Register 2000 (L. Panitch and C. Leys, editors), 41-52, Monthly Review Press: N.Y.

Klare, M., 2002, Resource Wars. Owl Books: N.Y.

Klare, M., 2004, Blood and Oil. Metropolitan Books: N.Y.

Klare, M., 2007,  
[http://www.motherjones.com/commentary/tomdispatch/2007/06/klare\\_pentagon\\_peak\\_oil.html](http://www.motherjones.com/commentary/tomdispatch/2007/06/klare_pentagon_peak_oil.html)

Kovel, J., 2002, The Enemy of Nature: The End of Capitalism or the End of the World? Zed Books: N.Y.

Marx, K. 1938 (reprinted). Critique of the Gotha Programme. International Publishers: N.Y.

Nelson, S., 2007, Rosie Revisited: A U.S.-Led Solution to Global Warming, [GlobalWarmingSolution.org](http://GlobalWarmingSolution.org)

Olivier, J.G.J., 1991, Inventory of aircraft emissions: a review of recent literature. RIVM

- Bilthoven - the Netherlands.

Pimentel, D., Hepperly, P., Hanson, J., Douds, D., and R. Seidel, 2005, Environmental, energetic, and economic comparisons of organic and conventional farming systems. *BioScience* 55: 573-582.

Scheer, H., 2007, *Energy Autonomy: The Economic, Social and Technological Case for Renewable Energy*. Earthscan: London.

Schwartzman, D., 1996: *Science & Society*, Fall, Special Issue "Marxism and Ecology", v. 60, No.3, Introduction (as guest editor): 261-265; *Solar Communism*, 307-331.  
[http://www.redandgreen.org/Documents/Solar\\_Communism.htm](http://www.redandgreen.org/Documents/Solar_Communism.htm)  
[http://www.redandgreen.org/Documents/Marxism\\_&\\_Ecology.htm](http://www.redandgreen.org/Documents/Marxism_&_Ecology.htm)

Schwartzman, D., 1998: Reply, *Science & Society*, Summer, 62, No.2: 272-274.

Schwartzman, D., 2005. Our Future Solar Utopia Revisited (abstract and talk), Technonatures session, The 37th World Congress of the International Institute of Sociology in Stockholm, July 5-9, 2005.  
[http://www.redandgreen.org/Documents/Our\\_Future\\_Solar\\_Utopia\\_Revisited.htm](http://www.redandgreen.org/Documents/Our_Future_Solar_Utopia_Revisited.htm)

Schwartzman, D, 2008, The Limits to Entropy: the Continuing Misuse of Thermodynamics in Environmental and Marxist theory. *Science & Society* v. 72, No.1, 43-62.  
<http://www.redandgreen.org/Documents/Limits%20to%20entropy%20final.htm>

Van Leeuwen, J-W. S. and P. Smith, 2004, *Nuclear Power: the Energy Balance*.  
<http://www.oprit.rug.nl/deenen/>

Vasilikiotis, C., 2005, Can Organic Farming "Feed the World"?  
[http://www.cnr.berkeley.edu/~christos/articles/cv\\_organic\\_farming.html](http://www.cnr.berkeley.edu/~christos/articles/cv_organic_farming.html)

Wallis, V. 2007, *Socialism and Technology: a Sectoral Overview*, Chapter 16, In: *Towards a New Socialism* ( A. Anton, and R. Schmitt, editors), 347-364, Lexington Books: Lanham.

Wasserman, H., 2006, *Solartopia! Our Green-Powered Earth A.D. 2030*.  
[www.harveywasserman.com](http://www.harveywasserman.com)