



The 21st Century Crisis: Climate Catastrophe or Socialism

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Abstract

Under the current trend, the world is on track towards an extreme greenhouse state that threatens to destroy human civilization and nearly all forms of life on Earth. Without an end to economic growth, it is virtually impossible for meaningful climate stabilization to be achieved. However, both capitalist enterprises and states are constantly driven to expand production and consumption. The climate change crisis is but one of several long-term historical trends that are now leading to the structural crisis of capitalism. The resolution of the crisis and the survival of humanity require the building of a fundamentally different social system.

JEL classification: B51, P16, P20, Q54

Keywords

climate change, limits to growth, structural crisis of capitalism, socialism

I. Introduction

The global average surface temperature is now about 0.8°C (0.8 degrees Celsius) higher than in pre-industrial times. Under the current trend, the world is on track towards a long-term warming between 4°C and 8°C. At this level of global warming, the world would be in an extreme greenhouse state not seen for almost 100 million years, devastating human civilization and destroying nearly all forms of life on Earth (Conner and McCarthy 2009).

The scientific community has reached consensus that the current global warming results from the excessive accumulation in the atmosphere of carbon dioxide (CO₂) and other greenhouse gases (such as methane and nitrous oxide) emitted by human economic activities.¹ The capitalist historical epoch has been characterized by the explosive growth of material production and consumption. The massive expansion of the world economy has been powered by fossil fuels (coal,

¹The Intergovernmental Panel on Climate Change concluded that the observed global warming since the mid-20th century was very likely to have been caused by rising anthropogenic greenhouse gas concentrations (IPCC 2007a). Despite the media hype of the so-called “climate gate” (caused by the leak of emails stolen from the Climate Research Unit at the British University of East Anglia), none of the basic scientific facts concerning climate change were challenged. See the open letter by 255 leading scientists on the issue (*Guardian* 2010).

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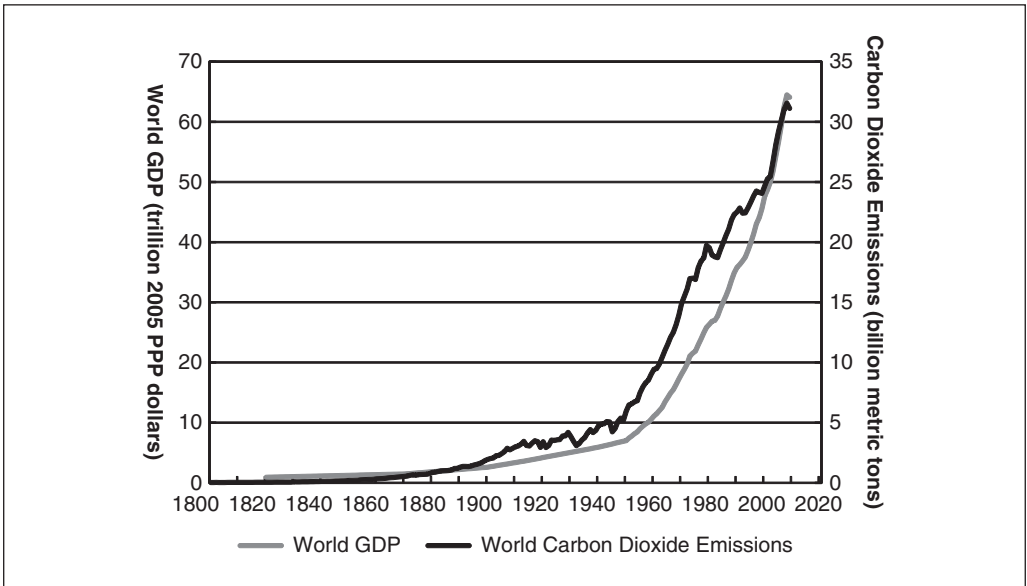


Figure 1. World GDP and carbon dioxide emissions from fossil fuels burning (1820–2009)
Sources: Maddison (2003); Earth Policy Institute (2008); World Bank (2010).

oil, and natural gas). Since 1820, the world economy has expanded by about seventy times and the world emissions of carbon dioxide from fossil fuels burning have increased by about sixty times (see Figure 1).

At the United Nations Conference on Climate Change concluded in Copenhagen in December 2009, the world's governments officially committed to the objective of limiting global warming to no more than 2°C. However, according to the “Climate Action Tracker,” despite the official statement, the national governments' current pledges regarding emission reduction in fact imply a warming of at least 3°C by the end of the 21st century with more warming to come in the following centuries (Climate Action Tracker 2010).

In reality, all the major national governments are committed to infinite economic growth and none of them is willing to consider any emission reduction policy that could undermine economic growth. This is not simply because of intellectual ignorance or lack of political will. The pursuit of endless accumulation of capital (and infinite economic growth) is derived from the basic laws of motion of the capitalist economic system. Without fundamental social transformation, human civilization is now on the path to self-destruction. The next section (section 2) reviews the basic scientific facts concerning the climate change crisis. Without an end to economic growth, it is virtually impossible for meaningful climate stabilization to be achieved (section 3). However, both capitalist enterprises and states are constantly driven to expand production and consumption. The system of nation states effectively rules out a meaningful global political solution to the climate change crisis (section 4). The climate change crisis is but one of several long-term historical trends that are now leading to the structural crisis of capitalism (section 5). The resolution of the crisis and the survival of humanity require the building of a fundamentally different social system that is based on social ownership of the means of production and society-wide planning (section 6).

2. Climate Catastrophe: The Crisis of the 21st Century

The world is currently about 0.8°C warmer than in pre-industrial times and continues to warm at a rate of about 0.2°C per decade. If global warming rises above 2°C, dangerous climate feedbacks

Table I. Global Warming Scenarios

Global warming scenarios	1–2°C	3–4°C	5–6°C
Drought and desertification	Frequent heat waves	Widespread drought and desertification	Much of the world ceases to be inhabitable
Sea ice and ice sheets	Disappearing of Arctic sea ice	Melting of Greenland ice sheets	Melting of Antarctic ice sheets
Sea level rise	Several meters	25 meters (?)	70 meters (?)
Ecosystems	One third of species become extinct	Amazon rainforest burns down	Massive species extinction
Human impact	Half a billion people at risk of starvation	Billions become environmental refugees	Global population may be reduced by 90 percent
Climate feedbacks	Possible initiation of soil and ocean carbon feedbacks	Arctic permafrost and ocean algae endangered	Runaway global warming

Sources: Spratt and Sutton (2008); *Guardian* (2009); Lovelock (2009).

may be triggered, leading to the release of more greenhouse gases from soil and ocean. For this reason, 2°C warming is generally considered by scientists as the “safe limit” beyond which global warming may be out of human control.

A 3°C warming would destroy the Amazon rainforest, leading to a further warming of 1.5°C. Southern Africa, Australia, Mediterranean Europe, and the Western United States would turn into deserts. Sea level could rise by 25 meters and billions of people could become environmental refugees.

With a 4°C warming, the melting of the Arctic permafrost could release massive amount of carbon dioxide and methane. Algae, the main carbon sinker in the ocean, would die out. The world is set for runaway global warming that could lead to additional temperature rises by several degrees.

If global warming rises to 5°C and above, much of the world would cease to be inhabitable and global human population could be reduced by 90 percent. Table 1 summarizes the potential consequences of various degrees of global warming (Spratt and Sutton 2008; *Guardian* 2009; Lovelock 2009).

In pre-industrial times, the amount of greenhouse gases, measured by atmospheric concentration of CO₂-equivalent (which measures the amount of *all greenhouse gases* in the atmosphere), was about 280 parts per million (ppm) (European Environment Agency 2009). According to the Intergovernmental Panel on Climate Change (IPCC), the “climate sensitivity” or the extent of global warming that would result from a doubling of the greenhouse gases in the atmosphere is estimated to be about 3°C. Thus, according to IPCC climate sensitivity, if the atmospheric concentration of CO₂-equivalent rises to 550 ppm, it should lead to an increase in global average temperature of about 3°C from pre-industrial times (IPCC 2007b).

However, new developments in climate science suggest that IPCC is likely to have underestimated the potential of global warming. Based on the study of paleoclimate data, James Hansen, one of the world’s leading climate scientists, concludes that when “slow” climate feedbacks (such as ice sheet disintegration and vegetation migration) are taken into account, the long-term climate sensitivity is about 6°C rather than 3°C (Hansen et al. 2008). Given the Hansen climate sensitivity, an atmospheric concentration of CO₂-equivalent of 550 ppm would lead to a long-term global warming of about 6°C.

Table 2. Climate Stabilization Scenarios (Gt: billion metric tons)

Climate stabilization scenarios	Scenario I	Scenario II	Scenario III
Atmospheric CO ₂ (ppm)	350	450	550
Atmospheric CO ₂ -equivalent (ppm)	450	550	700
Global warming ^a			
IPCC climate sensitivity	2°C	3°C	4°C
Hansen climate sensitivity	4°C	6°C	8°C
21st century carbon budget			
Cumulative CO ₂ emissions budget (Gt)	1,000	2,000	3,000
Less: deforestation emissions (Gt)	200	200	200
Cumulative fossil emissions budget (Gt)	800	1,800	2,800
Less: early 21st century emissions (Gt)	300	300	300
Remaining fossil emissions budget (Gt)	500	1,500	2,500

Sources: IPCC (2007b) and Hansen et al. (2008).

^aLong-term equilibrium temperature increase relative to pre-industrial time.

Currently, the atmospheric concentration of CO₂ (which measures *only carbon dioxide* in the atmosphere, other greenhouse gases not included) stands at nearly 390 ppm and is rising at an annual rate of about 2 ppm. The total greenhouse gases regulated by the Kyoto Protocol now stand at about 440 ppm CO₂-equivalent and are rising at a rate of about 3 ppm a year (European Environment Agency 2009). Without any further increase in greenhouse gases, the current level of greenhouse gases already implies a long-term warming of 2–4°C.

Table 2 summarizes the various scenarios of climate stabilization. Under Scenario I, atmospheric concentration of CO₂ eventually stabilizes at 350 ppm and total greenhouse gases stabilize at 450 ppm CO₂-equivalent. This will lead to a long-term global warming of about 2°C under the IPCC climate sensitivity but a 4°C warming under the Hansen climate sensitivity.

As more than 2°C global warming would significantly increase the risk of dangerous climate feedbacks and anything beyond 3°C warming would be devastating for human civilization, a responsible global climate policy should really aim at an atmospheric concentration of CO₂ at no more than 350 ppm. To achieve this objective, the cumulative carbon dioxide emissions over the entire 21st century must be less than one trillion metric tons.

In addition to emissions from fossil fuels burning, human activities also cause carbon dioxide emissions through deforestation and other land use changes. Currently, deforestation results in annual carbon dioxide emissions of about five billion metric tons. Suppose in the future deforestation is reduced to about one-third of the current level. The cumulative carbon dioxide emissions from deforestation over the 21st century may be limited to no more than 200 billion metric tons. This leaves the cumulative fossil emissions budget for the century to be about 800 billion metric tons.

However, over the first decade of this century, about 300 billion metric tons of carbon dioxide have already been emitted from fossil fuels burning. The remaining fossil emissions budget is therefore reduced to about 500 billion metric tons. The world currently emits about 30 billion metric tons of carbon dioxide each year from fossil fuels burning. Thus, at the current emission rate, the remaining fossil emissions budget required to achieve no more than 350 ppm CO₂ will be exhausted in 17 years.

At the current emission rate, the remaining fossil emissions budget required to achieve no more than 450 ppm CO₂ will be exhausted in 50 years. If the current emission rate is maintained through the rest of the 21st century, the cumulative fossil emissions will amount to three trillion metric tons, leading to the nightmarish Scenario III (with long-term global warming of 4–8°C).

3. Economic Growth and Climate Change

Despite the imminent threat of a global climate catastrophe, virtually all of the world's governments, major corporations, the entire mainstream economics discipline, as well as mainstream environmental groups continue to maintain that it is possible to achieve desirable climate stabilization while simultaneously pursuing infinite economic growth.²

The relationship between economic growth and carbon dioxide emissions can be explained by the following formula:

$$\text{Carbon Dioxide Emissions} = \text{World GDP} * \text{Emission Intensity of GDP}$$

Emission intensity of GDP is simply the ratio of carbon dioxide emissions over GDP. It follows that:

$$\text{Carbon Dioxide Emissions Growth Rate} = \text{World Economic Growth Rate} - \text{Rate of Decline of Emission Intensity}$$

According to the mainstream argument, capitalist technological progress will result in rapid declines of emission intensity, which will more than offset the growth of the world economy, leading to absolute declines of carbon dioxide emissions. If technological progress becomes sufficiently rapid, then the world economy could keep growing while global carbon dioxide emissions fall rapidly to meet climate stabilization objectives.

Given the current state of the climate change crisis, is this argument at all realistic? To stabilize atmospheric concentration of CO₂ at no more than 350 ppm, the cumulative fossil emissions over the rest of the century must not exceed 500 billion metric tons. It follows that the global carbon dioxide emissions from fossil fuels burning must fall at an annual rate of 5.5 percent through the rest of the century. By 2050, the annual emissions need to fall by about 90 percent from the current level.

If the goal is to stabilize atmospheric concentration of CO₂ at no more than 450 ppm (this would lead to the catastrophic long-term warming of 3–6°C), the cumulative fossil emissions over the rest of the century must not exceed 1.5 trillion metric tons. It follows that the global carbon dioxide emissions from fossil fuels burning must fall at an annual rate of 1.5 percent through the rest of the century. By 2050, annual emissions need to fall by about 50 percent from the current level.

In reality, over the decade 1999–2009, the world economy grew at an average annual rate of 3.5 percent, emission intensity fell at an average annual rate of 1.1 percent, and carbon dioxide emissions from fossil fuels burning had increased at an average annual rate of 2.4 percent. In 2009, the global economy suffered the deepest recession since the 1930s. Some had hoped that the “Great Recession” would help to greatly reduce the level of emissions.³ The emissions did fall, only by 1.3 percent (as the large reductions of emissions in the advanced capitalist countries were mostly offset by the rapid growth of coal consumption in China). If the world were to repeat the exercise of a “Great Recession” every year for the rest of the century, it would just fall short

²For example, both the IPCC reports (see IPCC 2007a) and the very influential Stern Report (Stern 2006) assume that economic growth will continue through the rest of the 21st century and beyond. For a critique of the IPCC and Stern reports, see Trainer (2009).

³In October 2009, the International Energy Agency predicted that the world carbon dioxide emissions from fossil fuel burning would have fallen by 3 percent in 2009 (IEA 2009). The actual emission reduction turned out to be much smaller.

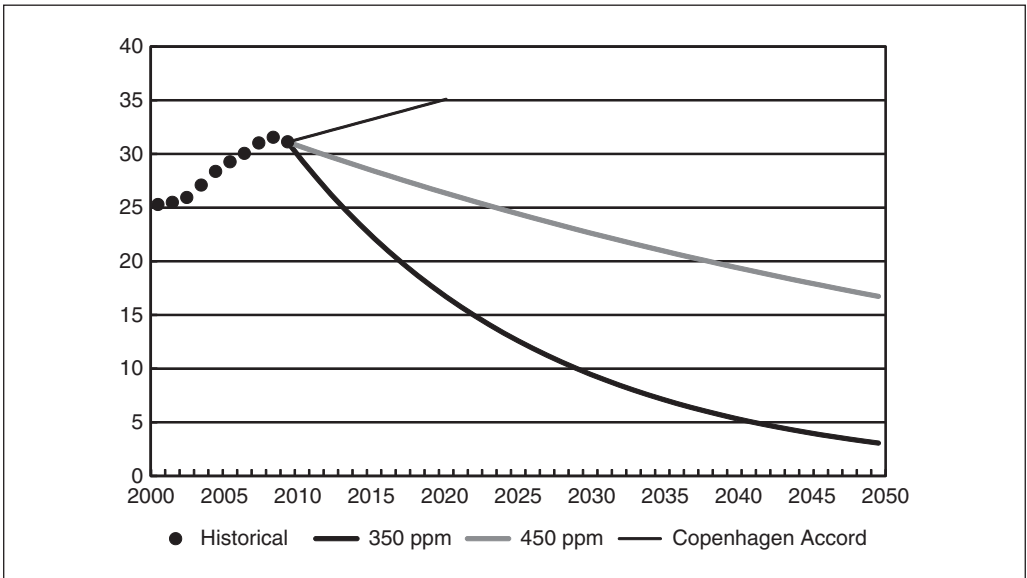


Figure 2. World carbon dioxide emissions from fossil fuels burning (alternative paths, billion metric tons, 2000–2050)

Sources: Climate Action Tracker (2010); World Bank (2010); the author's calculations.

of meeting the 450 ppm objective and not even get close to the 350 ppm objective (see Figure 2 for the emission paths required to meet the 350 ppm objective and 450 ppm objective).

If the world economy keeps growing at 3 percent a year (roughly the growth rate needed to keep the unemployment rate constant in the advanced capitalist countries), then to meet the 450 ppm objective, the emission intensity must decline at an annual rate of 4.5 percent (a quadrupling of the recent pace of emission intensity decline). To meet the 350 ppm objective, the emission intensity must decline at an annual rate of 8.5 percent. What miracle technology could deliver this?

Leave aside many other technical and economic difficulties involved in emission reduction; given the fact that the world's entire existing energy and industrial infrastructure is built around fossil fuels, sufficient emission reduction is simply impossible under the condition of infinite economic growth.⁴

Suppose each year the world replaces 5 percent of the existing energy infrastructure and the new energy capital stock reduces emission intensity by 50 percent compared to the existing capital stock. This is roughly equivalent to assuming that all of the world's new power plants and new motor vehicles are emission-free. With such heroic assumptions, it would only reduce the world's overall emission intensity by 2.5 percent a year. At this rate of emission intensity reduction, the world economy must contract at an annual rate of 3 percent to meet the 350 ppm objective.

4. Capitalism and Climate Change

Society's surplus product is the part of the total social product that is above what is needed to provide the population with basic consumption and replace the means of production consumed. Historically, surplus product tended to be used by a small group of elites for luxury consumption

⁴For economic and technical limitations of renewable and nuclear energies, see Trainer (2007).

and various wasteful activities. As a result, for much of human history, material production and consumption tended to either stagnate or grow very slowly.

Under capitalism, market relations have become the dominant mechanism of resources allocation. With universal market relations, capitalist enterprises are in constant and intense competition against one another. To survive and prevail in the competition, each capitalist enterprise is constantly under pressure to expand the scale of production. This in turn requires each capitalist enterprise to generate as much profit as possible and use much of the profit (surplus value) for the purpose of capital accumulation. Thus, capitalism is an economic system based on production for profit, and the operation of the system inevitably leads to the pursuit of endless accumulation of capital.

At the global level, capitalism has evolved as a system of nation states. The states engage in constant and intense competition against one another in economic and military struggles. To prevail in these struggles, each state is compelled to adopt policies and institutions that tend to favor capital accumulation and maximize economic growth. Those states that fail to promote economic growth tend to suffer from economic and political instabilities, and even cease to exist as viable states.⁵

Against this powerful tendency towards infinite economic growth, are there counteracting forces which may result in an equally powerful tendency towards falling emission intensity? According to neoclassical economics, if fossil fuels become scarce, prices of fossil fuels will rise, encouraging consumers to use less energy and capitalist enterprises to substitute renewable energies for fossil fuels. Under this scenario, as long as “the prices are right,” the market will arrive at the proper solution and there is nothing to worry about.

Of course, the problem is that in reality the prices are not right and greenhouse gas emissions have kept rising. The neoclassical solution to this problem is to treat greenhouse gas emissions as an “externality,” which is a market failure. But a market failure may be corrected by getting the prices right. Fossil fuel prices may be corrected through either a carbon tax or a “cap and trade” system that helps to take account of the environmental cost of fossil emissions.

But can we actually find a set of prices that could reduce the greenhouse gas emissions at a sufficiently rapid pace without seriously undermining capital accumulation and economic growth? In other words, within the limits of capitalist economic logic, do right prices exist in this particular case? As is discussed in the previous section, due to difficulties in infrastructure transformation and other limits, such “right prices” may simply not exist.

But suppose a set of right prices for fossil fuels can be found; how can they be implemented? If the problem has to do with an environmental externality within the boundary of a national capitalist economy, then it is conceivable that it may be effectively regulated by the national government to the extent the political situation allows the national government to effectively represent the long-term interest of the national capitalist class (a condition that is not always guaranteed).

But climate change is a global environmental crisis and the capitalist world system does not have a world government. Instead, it is a system made up of competing nation states. From the point of view of a nation state, to reduce fossil fuels consumption would mean either to reduce overall energy consumption or to replace fossil fuels with renewable energies that are more expensive and suffer from certain technical limitations. Thus, one way or the other, reducing fossil fuels consumption means a lower economic growth rate. Given these considerations, few states would unilaterally act to reduce fossil fuels consumption.

Historically, from time to time, successive hegemonic powers (the Netherlands in the 17th century, the United Kingdom in the 19th century, and the United States in the 20th century)

⁵For additional arguments that capitalism needs infinite economic growth to survive, see Magdoff and Foster (2010).

had acted as proxies for the world government in the capitalist world system, promoting the long-term interest of the system. Could the current hegemonic power effectively represent the systemic interest and lead the global cooperation required to tackle the climate change crisis?

U.S. hegemonic power has by now entered into irreversible decline. This is reflected in the fact that it can no longer effectively promote systemic interests and its current policies are often not in the system's long-term interest. On the other hand, none of the other major powers is now in a position to replace the United States and become the next hegemonic power to lead the system to overcome the current structural crisis.⁶

The inability of the existing system to overcome the global climate crisis was demonstrated by the Copenhagen fiasco. At the Copenhagen conference, the advanced capitalist countries (the United States, Western Europe, and Japan) had agreed to undertake only limited emission reductions and refused to provide adequate financial assistance to the "developing countries" to help their emission reductions.

In recent years, the so-called "emerging market" countries, and especially China, have become the leading contributors to global greenhouse gas emissions. China is already the world's largest carbon dioxide emitter and now accounts for fully one-quarter of global emissions. Thus, unless China and other emerging market countries undertake to reduce greenhouse gas emissions, there is no hope for meaningful climate stabilization to be achieved. Instead, China and India have only agreed to reduce "emission intensity" rather than emissions. In effect, China and India have reserved the right to keep consuming fossil fuels on an increasingly larger scale.

Figure 2 compares the alternative paths of world carbon dioxide emissions from fossil fuels burning from 2000 to 2050. The "Copenhagen Accord" path assumes that the major countries will reduce emissions or emission intensity in accordance with their respective pledges made under the Copenhagen Accord. The United States will reduce emissions by 20 percent by 2020 from the 2005 levels. Both the European Union and Japan will reduce emissions by 25 percent by 2020 from the 1990 levels. Russia will reduce emissions by 20 percent by 2020 from the 1990 levels. China's emissions will grow at an average annual rate of 5 percent between 2005 and 2020 (assuming an average annual economic growth rate of 8.5 percent and an average annual emission intensity reduction rate of 3.5 percent). India's emissions will grow at an average annual rate of 5 percent between 2005 and 2020 (assuming an average annual economic growth rate of 6.5 percent and an average annual emission intensity reduction rate of 1.5 percent). The above countries together accounted for 70 percent of the world's total carbon dioxide emissions from fossil fuels burning in 2005. The rest of the world's emissions are assumed to grow at an average annual rate of 1 percent between 2005 and 2020 (compared to an average annual growth rate of 2.3 percent between 1990 and 2005).

If the national governments actually deliver what they promised, by 2020 world emissions will be about four billion metric tons higher than current levels. The cumulative fossil emissions from 2000 to 2020 will have amounted to 650 billion metric tons, leaving only 150 billion metric tons in the remaining emissions budget if the goal is to limit atmospheric concentration of CO₂ to no more than 350 ppm. For all practical purposes, this would guarantee the 21st century to be the century of climate catastrophe.

5. The Structural Crisis of Capitalism

The impending climate catastrophe is but one of several aspects of the structural crisis of capitalism in the 21st century. We are currently at the beginning of a prolonged period of global instability

⁶On the decline of American hegemony and the inability of other big powers to succeed the United States as the next hegemonic power, see Arrighi, Silver, et al. (1999) and Wallerstein (2003).

and chaos. Similar periods of systemic chaos had happened before (for example, during the first half of the 20th century). Capitalism had managed to survive earlier crises, through institutional adjustments, without changing the system's essential features (production for profit and endless accumulation of capital).

Because of this historical observation, some have developed the belief that capitalism is such a remarkably "flexible" and "creative" system that it can always reform itself, adapt to change, survive crises, and meet challenges. But this belief is short-sighted and fundamentally ahistorical.

Like every other social system, for capitalism to exist and function it requires certain necessary historical conditions. Capitalism would remain viable (and therefore "reformable") only to the extent the necessary historical conditions required for its normal operations are present. But the development of capitalism inevitably leads to fundamental changes in the underlying historical conditions. Sooner or later a point will be reached where the necessary historical conditions are no longer present, and capitalism as a historical system will cease to exist.

If one compares the current systemic crisis with earlier instances of systemic crisis, what are some of the major differences? First, in previous periods of crisis, the world's natural resources remained relatively abundant and the global environment remained largely intact. Today, the global ecological system is literally on the verge of complete collapse. The impending climate catastrophe is only one among many aspects of global environmental crisis. Global capitalism has already exhausted the environmental space for further capital accumulation.

Second, the successful operations of the capitalist world system require it be regulated by an effective hegemonic power at the systemic level. However, with the decline of U.S. hegemony, no other big power was in a position to replace the United States and become the new hegemonic power. Without an effective hegemonic power, the system would be unable to pursue its own long-term interest and solve system-wide problems.

Third, in the past the capitalist system managed to survive crisis through social reforms. In essence, social reform is for the system to buy off certain opposition groups by making limited concessions. The concessions have to be limited so that they do not undermine the essential interest of the ruling class. Today, the system has run out of its historical space for social compromise.

In virtually all the advanced capitalist countries, now a restoration of favorable conditions for capitalist accumulation would require nothing short of large and sustained declines of working class living standards. Will the Western working classes simply surrender and give up their entire historical gains since the 19th century? If not, Western Europe and North America will again become major battlegrounds of class struggle in the coming decades.

Fourth, the world has reached an advanced stage of proletarianization. Marx famously predicted that the proletariat would become the grave diggers of capitalism. For the entire 19th and much of 20th century, the process of proletarianization was largely limited to the "West" (the advanced capitalist countries). In the neoliberal era, as capital is relocated from advanced capitalist countries to the rest of the world to exploit the reserve army of a cheap labor force, there have been large formations of industrial working classes in the non-Western world.

Over time, the non-Western working classes will develop the organizational capacity to demand a growing range of economic, social, and political rights. For the capitalist world system, if its economic and ecological resources are already so limited that it is no longer possible to accommodate the historical demands of the Western working classes, what is the chance for the system to accommodate the demands of the much larger non-Western working classes? If the system can no longer survive by buying off its potential opposition, can it simply survive by repression, and for how long?

How will the combination of these trends play out in the coming decades? Will the current structural crisis turn out to be the terminal crisis of capitalism? One thing is clear. If capitalism

does survive the current crisis, there is probably not much hope for humanity to survive the coming global climate catastrophe. For humanity's sake, end capitalism before we are ended by capitalism.⁷

6. Socialism and Climate Stabilization: What Is the Alternative?

When the existing system's advocates run out of arguments, their favorite and seemingly irrefutable response is always: what is the alternative? The implied message, of course, is that the critics of capitalism have no viable alternative to offer. The polemical response would have been an effective way to win the debate except for the matter that capitalism itself has ceased to be a viable historical option. The future of humanity lies elsewhere.

Suppose the coming global political struggle is resolved in a way that is in humanity's long-term interest, how can humanity be saved from the rapidly approaching climate catastrophe? How should the new economic system be structured for the purpose of meaningful climate stabilization, and to achieve broader objectives such as ecological sustainability and meeting the global populations' basic needs?

Under the conception of classical Marxism, the post-capitalist economic system is to be based on social ownership of the means of production and society-wide planning. These institutional arrangements are necessary to abolish not only capitalist exploitation but also the capitalist "anarchy of production" which leads to destructive economic crises and enormous social waste (Engels 1978[1880]).

The 20th century socialist states were influenced by the classical Marxist conception in their internal economic organizations. However, the 20th century socialist states remained a part of the capitalist world system, and to a large extent they were governed by the basic laws of motion of the capitalist world system, which contributed to their eventual demise.⁸

After the demise of Soviet-style socialism, an ideological consensus had emerged within mainstream economics and was shared by much of the intellectual left. According to this consensus, a socialist economy based on social ownership of the means of production with society-wide planning (where market relations are reduced to no more than a marginal role) is fundamentally flawed. As an economic system, socialism cannot work.

According to the mainstream critique, a socialist economy cannot work because it fails to solve the "information problem" (a modern economy is too complex for the planning authority to do effective planning), the "motivation problem" (without private property, no one is motivated to work hard and efficiently), and the "innovation problem" (without the financial reward for private risk-taking, there is no incentive for individuals to innovate and develop new technologies).⁹

In light of the actual historical development over the past several decades and the overwhelming challenge of global climate catastrophe confronting humanity today, can this mainstream critique of socialism be reevaluated? Even the fiercest critic of socialism would not deny that a socialist planned economy can produce thousands of different modern goods and services in large quantities, meet the basic needs of a large population, generate some technological progress, and

⁷Immanuel Wallerstein, the leading world system theorist, argues that the capitalist world system is unlikely to survive the mid-21st century (Wallerstein 2003). For elaborations on the structural crisis of capitalism that take into account both Wallerstein's and Arrighi's arguments, see Li (2008).

⁸On the historical lessons of 20th century socialism, see Kotz (1997) and Li (2008: 24-66).

⁹On the debate over socialist economics, see the special issue of *Science & Society* (Winter 1992), the special issue of *Review of Radical Political Economics* (Summer and Fall 1992), and Stiglitz (1994).

accomplish some achievements in science, culture, and education. So what exactly does it mean that “a socialist economy cannot work”?

What the mainstream critique is really saying is not that a socialist economy cannot produce and innovate, but that because socialism supposedly solves the information, motivation, and innovation problems less effectively, it fails to deliver as rapid economic growth as capitalism. Leave aside the question whether this critique can be applied to possible democratic socialism in the future; given today’s historical context, this mainstream critique is no longer relevant.

It has been argued above that it is impossible to achieve meaningful climate stabilization under the condition of infinite economic growth. To achieve meaningful climate stabilization, the most basic requirement for any future economic system is that it has to be based on the commitment to a steady-state economy. That is, the economy must operate with zero economic growth, and with levels of material consumption consistent with the normal operations of the ecological system.¹⁰

Capitalism clearly fails to meet this requirement. There is no direct historical evidence suggesting that a socialist economy can operate as a steady-state economy. The historical socialist states were all committed to the pursuit of rapid economic growth. But this was because the historical socialist states were surrounded by powerful capitalist states and had to expand industry and military in order to survive.

Even though there has been no precedent of a socialist steady-state economy, given the general understanding of the operational mechanism of a socialist planned economy, it is not difficult to imagine how socialism can achieve a steady-state economy. To achieve zero economic growth, the planning authority could simply decide to use society’s surplus product for social consumption (such as education, health care, science, and culture) rather than accumulation. Alternatively, the planning authority could decide to reduce the working time for every social member so that the size of the surplus product is reduced to a level consistent with zero economic growth.

Given the urgency of the climate change crisis, to achieve meaningful climate stabilization, it is necessary for the society to undertake rapid and massive transformation of society’s economic infrastructure. For example, if the world immediately commits its entire new power plant building capacity to the building of renewable electricity and transforms the transportation system into one that is based on electrified public transportation, then under the condition of no economic growth the world may be able to reduce global greenhouse gas emissions by half by the mid-21st century, roughly meeting the 450 ppm objective. Additional energy savings and some sacrifice of living standards would be required to achieve the 350 ppm objective.¹¹

To realize this plan, society needs to rapidly mobilize all available resources and direct these resources to the purpose of climate stabilization. There is no historical evidence suggesting that a capitalist market economy is capable of this kind of massive mobilization. By contrast, it is widely recognized that a socialist planned economy tends to be very effective in mobilizing society-wide resources and using the resources for a clearly defined social objective. Some environmentalists have argued that to achieve meaningful climate stabilization, the advanced capitalist countries need to learn from their Second World War experience and undertake a wartime-like mobilization (Spratt and Sutton 2008). But the wartime economies were nothing but quasi-centrally planned economies.

¹⁰On the requirements of ecological sustainability and the necessity of economic steady-state, see Huesemann (2003).

¹¹The power generation sector accounts for about 35 percent of the world’s total carbon dioxide emissions from fossil fuels burning. Transportation accounts for about 20 percent. Thus, the decarbonization of both the power sector and the transportation sector would reduce emissions by about 50 percent if there were no economic growth.

Cuba provided an actual example of how socialism could achieve rapid energy transformation without undermining the population's basic needs. After the demise of the Soviet Union, Cuba was confronted with a severe energy and economic crisis. Under the socialist planning system, Cuba undertook a difficult but successful transition from a conventional oil based economy into an ecologically more sustainable economy while maintaining basic social achievements.¹²

Given that human greenhouse gas emissions and many other pollutions have already overshoot the natural limits by large margins, the restoration of global ecological sustainability could require not only the establishment of a steady-state economy but also significantly lower levels of material consumption.¹³ If that is the case, the question is how to lower global material consumption to achieve ecological sustainability without undermining the basic needs of the global population.

In this respect, the historical socialist states had been very effective in providing the general population with basic needs, especially under comparatively low levels of material consumption and in comparison with capitalist states of similar levels of economic development.¹⁴

Back to the question: can socialism work? We have seen that it can meet the general populations' basic needs with limited material resources. We have seen that it can undertake rapid and massive infrastructure transformation, the kind of transformation required for meaningful climate stabilization. We have not seen, but we have very good reason to believe, that it can operate effectively as a steady-state economy. Because of these reasons, socialism can save humanity.

If this is not good enough, then what is the alternative?

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¹²On Cuba's energy transition and the development of sustainable agriculture, see Pfeiffer (2006: 53-65).

¹³According to the *Living Planet Report*, the world's ecological footprint (a measure of humanity's demands on the planet's resources) has already exceeded the planet's regenerative capacity by about 30 percent (WWF, ZSL, and GFN 2008).

¹⁴This was reflected by the much better health indicators of the socialist states in comparison with capitalist states of similar levels of economic development. See Navarro (1993).

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Bio

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