GREEN CAPITALISM

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Introduction

Green capitalism is a new economic system that values the natural resources on which human survival depends. It fosters a harmonious relationship with our planet, its resources, and the many species it harbors. It is a new type of market economics that addresses both equity and efficiency.[1] Using carbon negative technology, it is possible to reduce carbon in the atmosphere while fostering economic development in rich and developing nations, for example in the United States, the European Union, China, and India. How does this work?

In a nutshell, Green Capitalism requires the creation of global limits or property rights for the use of the atmosphere, the bodies of water, and the planet's biodiversity, and the creation of new markets to trade these rights. From this, new economic values emerge, as does a new concept of economic progress that goes beyond GDP.[2]

Green Capitalism can help avert Climate Change and achieve the goals of the 2015 United Nations Paris Agreement, which are very ambitious and almost universally supported but have no way to be realized within the agreement itself. Green Capitalism is needed to achieve the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report which focuses on averting catastrophic Climate Change. The Kyoto Protocol carbon market and its Clean Development Mechanism (CDM) can also play critical roles in the foundation of Green Capitalism by using carbon negative technologies to help the world remain within the world's "CO2 budget."

Below are the building blocks for Green Capitalism and practical examples of how these organizing principles can be put into practice. They illustrate how new carbon negative technologies can help achieve the climate negotiation goals, averting climate change.

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Building Blocks For Green Capitalism

The three building blocks for Green Capitalism are:

1. Global limits imposed nation by nation in the use of the planet's atmosphere, water bodies, and biodiversity.
2. New types of markets to trade these limits, based on equity and efficiency, which are relatives of the Kyoto carbon market and the Sulphur dioxide (SO2) market. Their prices create new measures of economic value and update the concept of GDP.
3. Efficient use of carbon negative technologies to remain within the world's carbon budget and avert catastrophic climate risks, providing a transition to clean energy and ensuring economic prosperity in rich and poor nations.

The building blocks have practical implications. On the basis of these blocks it is possible to resolve key goals of global policy. For example, we could create a $200 billion per year Green Power Fund from existing funding sources, including the Kyoto CDM, to ensure a smooth and accelerated transition to clean energy, achieving the goals of the UN Kyoto Protocol, the Paris Agreement, and of the UN Green Climate Fund.

The building blocks offer practical ways to avert climate change and assist the ambitious goals of the Paris Agreement, which cannot be achieved within the Agreement's terms themselves.

Indeed, according to the 2014 IPCC Fifth Assessment Report, carbon negative technologies, also known as carbon removal, are now needed on a massive scale in our century in order to avert catastrophic climate change.

Below are practical examples of how these building blocks can help achieve the goals of the UNFCCC, using carbon negative technologies while fostering growth in developing nations and overcoming poverty, all of which require more energy supplies.

Carbon Negative Power Plants For Developing Nations

New generation technologies can capture CO2 from the atmosphere at low cost.[3] These technologies can be used to build carbon negative power plants that clean the atmosphere of CO2 while producing electricity.[4] Global Thermostat LLC is an award-winning firm that can be used as an example. The firm is commercializing a technology that takes CO2 out of air and uses low-cost residual heat rather than electricity to drive the capture process, making the entire process of capturing CO2 from the atmosphere inexpensive. There is enough residual heat in a coal power plant that to capture twice as much CO2 as the plant emits, thus transforming the power plant into a "carbon sink." For example, a 400 MW coal plant that emits 1 million tons of CO2 per year can become a carbon sink instead.[5] Carbon capture

from air can be done anywhere and at any time, and so inexpensively that the CO2 can be sold for industrial or commercial uses such as food and beverages, water desalination, greenhouses, bio-fertilizers, building materials, and even enhanced oil recovery, all examples of large global markets and profitable opportunities. Carbon capture is powered mostly by low (85°C) residual heat that is inexpensive, and any source will do. In particular, renewable (solar) technology can power the process of carbon capture. It can help advance solar technology and make it more cost-efficient. This means more energy, more jobs, and also more economic growth in developing nations, while cleaning the CO2 in the atmosphere.

Carbon negative technologies can transform the world economy. In recognition of this fact, Global Thermostat has received several prominent awards.[i]

The Role Of The Kyoto Protocol Carbon Market

The roles of the Kyoto Protocol carbon market and its Clean Development Mechanism (CDM) are critical, as they can provide needed funding and incentives for investment in building carbon negative power plants, as described above, in developing nations. To provide access for all nations to the carbon market, the Kyoto carbon limits must be generalized for all nations, since no carbon market can operate without carbon emissions limits.

The CDM can be used to provide "off-takes," namely contracts that promise to buy the electricity that is provided by carbon negative power plants for a number of years. Using these off-takes as validation of future revenue unlocks banking resources for the investment required to build carbon negative power plants. Carbon negative power plants can be profitable, since their costs are low and they produce electricity. The scheme covers fixed costs and amplifies profits from clean technologies. Private capital markets recognize the business potential of clean technologies, having achieved a scope of $260 billion a year in today's markets.

The Green Power Fund And Global Capital Markets

To accelerate and enhance the impact of the UN carbon market and its CDM, it is possible to create a $200 billion a year private-public fund, also called the Green Power Fund. The fund can be used to build carbon negative power plants in developing nations, particularly in Latin America and Africa, enhancing their economic development while cleaning the planet's atmosphere.

The Green Power Fund was named and proposed by the U.S. Department of State in COP15, held in Copenhagen in December 2009, and I published it in *Financial Times* in 2009. It was accepted by the U.S. Department of State, and

[i] Including "World's Top Ten Most Innovative Company in Energy" from *Fast Company Magazine* and "World's Top 50 Innovator in Renewable Energy" by *AltEnergyMag*.

two days later, then-Secretary of State Hillary Clinton offered it up as the United States' contribution in the global negotiations in COP15. One part of it, called the Green Climate Fund—one word was changed—became international law and received substantial financial support. Most of the financial promises to the Green Power Fund, unfortunately, have not been delivered. The Green Climate Fund lacks the funding which Kyoto and its carbon market could provide if a link was made between the two. But the United States has not ratified the Kyoto Protocol and therefore has severed this natural and desirable source of funding. The connection can still be worked out while reinstating nation-by-nation carbon limits after 2020, as needed for the carbon market. Funding can be raised from global capital markets to invest in investment grade firms that build carbon negative power plants in developing nations, with access to CDM funding to provide off-takes to buy the ensuing electricity.

The background and financial feasibility of the Green Power Fund can be seen as follows. Existing technologies can efficiently and profitably transform coal power plants and solar thermal sources of energy into "carbon sinks" that reduce atmospheric carbon concentration while producing electricity. The more electricity is produced, the more residual heat is released, which drives the new generation carbon capture technologies.

The Green Power Fund provides the project finance that is needed to build carbon negative power plants in developing nations and elsewhere. This can accelerate the renovation of the $45 trillion to $55 trillion power plant infrastructure worldwide (according to the IEA), which is 87 percent fossil today, to transform it into a powerful "carbon sink" that cleans the atmosphere of CO2. Financially, what is required is about $200 billion per year for 15 years. By 2011, the UN carbon market was already trading $175 billion per year, which almost suffices to cover these costs. The funding would go to investment-grade power plant builders to build carbon negative power plants in developing nations.[ii] This is what the carbon market can trade per year, thus providing the funding required.[6] Therefore, the financial target proposed here is eminently achievable.

Green Capitalism And Traffic Lights For Human Survival

The building blocks I propose include new types of markets that can transform capitalism into Green Capitalism. This is achieved by transforming the economic values and prices of the new economy, providing market incentives that make green economic projects more profitable than their alternatives, and fostering the conservation of biodiversity, clean water and a safe atmosphere. Some of these new markets already exist and are described above. Green markets change GDP by

[ii] Includes General Electric, SSE, Siemens, Linde, as well as new and smaller firms.

valuing the global commons (the atmosphere, biodiversity, clean water), which in turn changes the measure of economic progress defined as the sum of all goods and services produced by an economy at market prices. As pointed out by *The Economist*, well-known economists James Tobin and Bill Nordhaus gave examples showing that, at present, the measure of GDP "treats the plunder of the planet as something that adds to income, rather than a cost." [7,8] For example, cutting down all the trees in U.S. national parks and making toilet paper from their wood increases U.S. GDP and counts as economic progress. This is because GDP uses current market prices in its computations. Toilet paper has a market price, since there is a market for toilet paper, while there is no market for standing trees in the streets or in national parks.

How Green Markets Change The Measure Of Economic Progress And Redefine Gdp

The creation of green markets that trade the use of the global commons—such as the rights to emit CO2, to use drinkable water, and to exploit biodiversity—changes the measure of economic progress. The carbon market, for example, changes the GDP of a nation. For example, if two nations, which we can call Solar Nation and Coal Nation, produce exactly the same goods and services at the same cost but with the first using solar energy and the second coal, then the GDP of Solar Nation will be significantly higher than the GDP of Coal Nation on any given year. This is because, if Coal Nation emits too much CO2, it has to pay Solar Nation, which emits none. The difference makes Solar Nation's GDP higher and Coal Nation's GDP lower. In reality, the purchase and sale of carbon credits now enters the computation of GDP, giving a positive edge to Solar Nation and a negative one to Coal Nation. This is exactly what we wish to achieve: a GDP that measures the damages that Coal Nation is doing to the environment, the nation, and indeed the entire world.

Green markets that trade global public goods link equity with efficiency. This is different from standard markets for private goods, in which equity and efficiency are unrelated. Examples of global green markets are:

- The UN Carbon Market (EU ETS), which has been international law since 2005.
- The SO2 Market in the U.S., which started trading at the CBOT (Chicago Board of Trade) in 1991. Markets for Water and Markets for Biodiversity: these are still to emerge as proposed by the author, and they are under U.N. consideration.

These markets provide missing signals that are normally provided by market prices when a good or service becomes scarce. Such signals are tantamount to traffic lights for human survival. Here are signposts to implement the above strategies going forward within the UNFCCC Global Climate Negotiations and the annual COP meetings, the last two of which were COP22 in Marrakesh in 2016 and COP23

in Bonn in 2017. We were able to insert the carbon market in December 1997 into the COP3 in Kyoto; in Copenhagen in 2009 we inserted wording into the CDM allowing carbon negative technologies to be compensated as part of the CDM so that the CDM may fund negative carbon technologies; and four articles on carbon removals or carbon negative technologies were inserted in the Paris Agreement in COP21, December 2015.

Economic Incentive For The Short And Long Run: Why Negative Carbon?

Long-run strategies do not always work for the short run, as different policies and different economic incentives are required for the short run.

In the long run, the best policy is to replace fossil fuel sources of energy—which by themselves cause 45 percent global emissions—with clean energy, and to plant trees to restore natural sinks of CO2. However, fossil fuel power plants make up about 87 percent of global power plant infrastructure, worth about $55 trillion. This makes it clear that fossil fuels cannot be replaced quickly, certainly not in the two or three decades in which we need to take action to avert catastrophic climate change. Once emitted, CO2 remains in the atmosphere for hundreds of years, and we have emitted so much that unless we actually remove the CO2 that is already there, we cannot remain long within the carbon budget, the concentration of CO2 beyond which we expect catastrophic climate change.[9] In the short run, therefore, the IPCC indicates in its 2014 Fifth Assessment Report that we must actually remove the carbon that is already in the atmosphere, and in massive quantities, in this century.[10] This is a carbon negative approach that works for the short run. Renewable energy is a long run solution.

Renewable energy is too slow for the short run, since replacing a $45 trillion power plant infrastructure with renewable plants could take decades. We have already seen that planting trees is not feasible either, for similar reasons. We need action sooner than that. For the short run, we need carbon negative technologies that capture more carbon than what is emitted. Trees do that—and they must be conserved to help preserve biodiversity. Biochar does that, but trees and other natural sinks are too slow for what we need today, as discussed above.

Negative Carbon Leads To A Global Economic Transformation

Negative carbon is needed now as part of a blueprint for transformation. It is needed for sustainable development and its short-term manifestation, Green Capitalism. In the long run, only renewable sources of energy will do, including solar, wind, biofuels, nuclear, geothermal, and hydroelectric energy. Of these, only solar energy suffices to replace fossil fuels; the rest are in limited supply and cannot replace fossil fuels. Global energy today is roughly divided as follows: 87 percent

is fossil, namely natural gas, coal and oil; 10 percent is nuclear, geothermal, and hydroelectric; and less than 1 percent is solar power—photovoltaic and solar thermal. Nuclear fuel is scarce and nuclear technology is generally considered dangerous, as per Japan's tragic experience in 2011 at the Fukushima Daishi nuclear power site. It seems unrealistic to seek a solution in the nuclear direction. Only solar energy can be a long-term solution at present: less than 1 percent of the solar energy we receive on Earth can be transformed, with existing technologies, into ten times the fossil fuel energy used in the world today.

Yet we need a short-run strategy that accelerates long-run renewable energy or we will defeat long-run goals. In the short run, as the IPCC validates, we need carbon negative technology. The short run is the next 20 or 30 years. There is no time in this period to transform the entire fossil infrastructure—it costs $45 trillion (according to the International Energy Agency (IEA)) to replace. We need to directly reduce carbon in the atmosphere now. We cannot use traditional methods to remove CO2 from smokestacks (often called Carbon Capture and Sequestration, or CSS) because they are not carbon negative, as is required. CSS works but does not suffice because it only captures what power plants emit currently. Any level of emissions adds to the stable and high concentration we have today. We need to remove the CO2 that is already in the atmosphere. What is needed is air capture of CO2 which the IPCC calls carbon removals.

One solution is to combine air capture of CO2 with storage of CO2 into biochar, cement, polymers, and carbon fibers that can replace a number of other construction materials such as metals.[iii] It is also possible to combine CO to produce renewable gasoline, namely gasoline produced from air and water. CO2 can be separated from air, and hydrogen separated from water, and their combination is a well-known industrial process for producing gasoline. There are also new technologies using algae that make synthetic fuel commercially feasible at competitive prices.

Other policies involve combining air capture with solar thermal electricity, using the residual solar thermal heat to drive the carbon capture process. This could make solar plants more productive and efficient as a source of energy.

In summary, the blueprint offered here is a private-public approach based on new industrial technology and financial markets. It is self-funded and could use carbon credits and the Kyoto Protocol CDM, fostering mutually beneficial cooperation between industrial and developing nations. The blueprint provides two sides of the coin: equity and efficiency.

Our vision is a carbon negative economy with green capitalism resolving the global climate crisis and the North– South divide. In the examples provided above, carbon negative power plants and the capture of CO2 from the air together ensure

[iii] For example, a recent BMW automobile model uses only carbon fibers rather than metals.

a clean atmosphere coupled with economic development: as more energy and jobs are created, the cleaner the atmosphere becomes.

In practice, Green Capitalism means economic growth that is harmonious with the Earth's resources.

Notes

[1] Graciela Chichilnisky, "Forward Trading Between the U.S. and China," *Time*, 5 October 2009, http://content.time.com/time/magazine/article/0,9171,1925910,00.html.

[2] See 30 April 2016 issue of *The Economist*, "The Prosperity Puzzle," for additional information.

[3] See www.globalthermostat.com.

[4] Graciela Chichilnisky and Peter Eisenberger, "Carbon Negative Power Plants," *Cryogas International*, May 2011, p. 36.

[5] Ibid.

[6] See, The World Bank's annual report, "Status and Trends of the Carbon Market," from 2010 and 2011.

[7] "The Trouble with GDP," *The Economist*, 30 April 2016, https://www.economist.com/briefing/2016/04/30/the-trouble-with-gdp.

[8] Ibid.

[9] Graciela Chichilnisky and Peter Eisenberger, "Carbon Negative Power Plants," *Cryogas International*, May 2011, p. 36.

[10] Intergovernmental Panel on Climate Change, "Climate Change 2014 Synthesis Report," published 2015, p. 63.