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Avoiding Extinction

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AVOIDING EXTINCTION

What Next?

For the first time ever, humans dominate Planet Earth. We are changing the basic metabolism of the planet: the composition of gases in the atmosphere and its bodies of water, and the complex web of species that makes life on Earth. What comes next?

The changes we are precipitating are fundamental and can lead to disruptions in climate and global warming. Signals abound: in the Southern hemisphere alpine glaciers and Antarctic ice sheets are melting; in the Northern hemisphere Alaska's permafrost is melting, sinking entire towns whose inhabitants are being relocated at a cost of \$140,000 per person. Greenland's ice sheet is gone, creating hostile climate conditions for a number of species that are now close to extinction such as the polar bear. In Patagonia and the Alps we observe mountains without ice or glaciers, reducing the ability of these regions to store water needed for human consumption. In the Caribbean seas 50% of corals are already extinct. Desertification has overtaken 25% of China's land mass. Climatic instability has led to Australia's longest draught on record, followed by the worst floods in that continent's history. We observe disappearing summer ice in the Arctic Seas and soil erosion and storm surges in Alaska. Where is all of this coming from? The rapid industrialization of wealthy nations during the last century is responsible for most of the changes and for the risks they entail. Historically the industrialized nations in the Organization of Economic Cooperation and Development (OECD) originated 70% (now still 60%) of all global emissions of carbon, emissions that most scientists in the world, including those in the United Nations Intergovernmental Panel on Climate Change, believe to cause climate change. China's relentless industrial growth over the last two decades is a sign of things to come: it accelerates the risk of climate change and underscores the fact that in 20 or 30 years into the future most emissions could come from today's poor nations as they assume their turn to industrialize.

Water expands when it warms, and seas are rising all over the world. The rising waters will sink the 43 island states in the United Nations, which represent 23% of its vote. Most of them will disappear soon under the warming seas.

The world is aware of the connection that scientists postulate between climate change and the use of fossil energy. The largest segment of carbon emissions, 40-45% of all global emissions of CO₂, originate in the world's power plant infrastructure, 87% of which are fossil fuel plants that produce the overwhelming majority of the world's electricity (IEA, 2012). This infrastructure represents US \$55 trillion according to the International Energy Agency, about the size of the world's economic output. New forms of clean energy are emerging such as wind farms in Scotland and solar farms in Spain in an attempt to forestall carbon emissions. But the process is slow since the world's power plant infrastructure is comparable to the world's GDP, and changing this will take decades. This timeframe is too slow to avert the potential catastrophes that are anticipated in the next 10 – 20 years. What, then, is the solution?

Below we propose a realistic plan that involves market solutions in both industrial and developing nations, simultaneously resolving the problems of economic development and climate change and helping overcome the global wealth divide. But the climate change issue is just one of several environmental areas that are in crisis. Biodiversity is another: industrialization and climate warming threaten ecosystems. Endangered species include sea-mammals, birds such as cockatoos, polar bears, and marine life such as coral, sawfish, whales, sharks, dogfish, sea-turtles, skates, grouper, seals, rays, and bass; the survival even of primates, our cousins in evolution is at risk. Scientists say that we are in the midst of the 6th largest extinction of biodiversity in the history of Planet Earth, and the scope of extinction is so large that 75% of all known species are at risk. The UN Millennium Report documents rates of extinction 1,000 times higher than is found in fossil records. The current 6th largest extinction event follows the dinosaurs' extinction, which took place 65 million years ago. But today's extinction event is unique in that it is caused, created, by human activity. And it puts our own species at risk. 99.9% of all species that ever existed are now extinct. Are we to be next? Will humans survive? The issue now is how to avoid extinction.

Women, Energy and Survival

To avoid extinction we have to develop survival skills. A simple but somewhat unexpected experimental finding involves colonies of bacteria, microorganisms that are

the world's oldest living species. They have been around for billions of years and biologists agree that they have shaped the planet's geology and atmosphere to suit their needs. Bacteria are champions of survival. New findings show that *Escherichia Coli*—and most known bacteria colonies—when exposed to a pathogen or stressor such as antibiotics not only evolve to develop resistance but the evolved members produce specific resistance tools that they do not need in order to share with the rest of the (non-evolved) members of the colony (Youk and van Oudenaarden, 2010). In other words, when exposed to stress, mutant bacteria use some of their own energy, altruistically, to create a chemical called “*indole*” that protects non-mutants from the pathogen. This way the entire group survives. Bacteria—those champions of survival—have developed and mastered altruism for survival.

Human survival skills have focused so far on avoiding natural risks and confronting successfully the threats posed by other species that preyed on us, species that are dangerous to us. Altruism is often considered a weakness in human societies, a desirable trait rather than a survival skill. Yet altruism is a survival skill. Aggressive and individualistic behavior may have been a useful survival tool until now. The war society that humans have created has become an efficient killing machine. But things are changing and what used to be a strength can become a weakness. Survival is about protecting life not just about inducing death. Life is difficult to define, but we all agree that it is a phenomenon characterized by reproduction. To be alive means to be part of a time series of reproductive activities. Reproduction characterizes life. Destruction does not. Asteroids destroy very effectively, and so do volcanoes. But they are not alive, because they do not reproduce. We humans are alive because we do. And reproduction fundamentally requires altruism rather than dominance and aggression. We must donate our energy and even our bodily resources and substance to be able to reproduce, sometimes at the cost of our own.

In our male-dominated society the essence of life is viewed differently, mostly as the ability to conquer, dominate and kill. Men think of life skills as those skills that allow them to win the battle for survival. War is an example. Ask any man what characterizes life. A common male answer would be “the survival of the fittest” and “dog eats dog.” This is a typical male view of life. It may be so because the evolutionary role that males

originally had in human societies, a role that is now somewhat outdated. The great British author and social commentator Jonathan Swift once suggested, as a ‘modest proposal’ to the problem of poverty in Ireland, that humans should eat their own children (Swift, 1729). This helps to illustrate a point I want to make. If the essence of life was the survival of the fittest, then humans would eat their children who are totally powerless at birth—nothing is less fit than newborn infants. Why don’t we follow Swift’s ‘modest proposal’? Why not eat our own children?

Because no species that ate its children would survive—it may not even get started as a species. Survival depends crucially on reproduction and this means protecting the weakest of all—the small children. This is quite different from the blanket policy of survival of the fittest, which are the adult members of the species. Indeed, I venture to say that survival is more than anything about altruism and cooperation, and about the protection of the weakest. It is not about ‘dog eat dog’; it is not about dominance and survival of the fittest. The precise features of this point can be disputed, but the general drift of the argument—that our male-dominated society is more aggressive and violent than would be desirable and gives relative little importance to nurturing and altruism—is not. The recent Newtown tragedy in Connecticut made this clear.¹ Women understand this because their evolutionary role is to protect the weakest of all—namely the children at birth. Many men miss this important aspect of survival because their evolutionary role appears to value physical strength more than anything else, a role that seems increasingly out of date.

It was fitting therefore that I was invited by ECU to address the issue of ‘avoiding extinction’ in March, which is Women’s History Month. Women’s History Month takes place in the midst of a male dominated world and a male dominated culture that is focused on violence, economic competition and wars of choice. Among the changes we need to avoid extinction, we need to assure a changing role for women such that the entire ethos of destruction and dominance that permeates much of our society is balanced out by a modicum of altruism, the care for each other, and the necessary nurturing and

¹ In the USA, the Newtown incident in which 22 school children were tragically killed touched a raw nerve. Based on this, the Obama Administration attempted to decrease the availability of arms in an attempt to lessen the consequences of mindless violence.

protection of the weakest. President Obama said as much in his acceptance speech for his second term.

It is true that there have been changes in the role of women, most of all their rapid entrance in the market for labor in industrial societies. But change has not been fast enough. Modern societies like the US have enormously high rates of abuse of women at home and elsewhere, both physical and economic abuse. The US has a 30% gender difference in salaries, which does not budge, even when comparing men and women of equal training, same age and experience. The gender inequality is prevailing, persistent and systematic. In any given society, there is a deep connection statistically between the amount of housework a woman does at home and the difference between male and female salaries in the economy as a whole. These are two different statistics that are apparently unrelated, but they are indeed related, because when women are overworked and underpaid at home this leads them to be overworked and underpaid in the marketplace (Chichilnisky, 2011). Gender inequality in salaries is in reality legally sanctioned—for example the US still does not have an Equal Pay Act. Unequal pay is legal in the USA. Why? Is there a reason to pay women less than men? If so, what is it?

The deepest suspicion created by sexism to explain the persistent unequal situation is based on a rationale of the “genetic inferiority” of women. Even a former president of the oldest University in the US, Harvard University, Larry Summers, presented this suspicion in public as a plausible hypothesis to explain one aspect of gender discrimination, the 30% difference in salaries between women and men in our economy. He was subsequently fired by the Harvard University faculty he served, but went on to become the lead economic advisor of President Obama. One wonders whether Mr. Summers would have been selected as an economic advisor of the President of the US—the first black president—if he had presented in public his suspicions about the genetic inferiority of blacks rather than of women. I venture to say that he may not have been selected by President Obama if he had said in public that blacks were genetically inferior. But saying this about women is acceptable, and indeed it was rewarded despite his unfortunate public statements. This was discouraging for some of us, but not for many US men who secretly or openly believe that women are indeed genetically inferior to men.

Raising in public the hypothesis of the genetically inferiority of women is not an innocent remark. It is a way to justify a systematic way in which male dominated societies perpetrate economic and cultural abuse, violence against women, pornography, torture of women and rape, all of which represent a form of social control and intimidation, and ultimately reveals a deep social instinct against the altruism, protection of the weak and reproductive sensibility that women bring to society and that is a necessary precondition for the survival of our species. Until we change the current male dominated culture of abuse and violence against women, which is so well known that it has been taken up explicitly by lawmakers in the US Congress and Senate; until we revolt against the seeming ubiquity of electronic games that the US Supreme Court found acceptable for children in their 2011 decision, games involving the systematic torture and killing of women as entertainment; and until we develop altruism and nurturing as efficient survival skills, our society will not be well prepared to avoid extinction.

Survival in poor nations depends critically on the availability of energy, and women are often the providers of energy in fetching wood and dung for heat and cooking, water and food for human consumption. Clean energy is needed to replace the role of women as beasts of burden in many poor nations.

Avoiding Extinction

The future of humankind may be played out in the rest of this 21st Century. We face energy limits confronting enormous global needs now and in the future. The overuse of natural resources continues to be a clash of civilizations: it is a North/South impasse in using the world's resources. The North includes the rich nations that inhabit mostly the Northern hemisphere of planet, about 20% of the world's population that consume most of its natural resources. The South represents the poor nations, about 80% of the world's population, who consume the rest. We will examine the market's role in creating the problem and in finding a solution. We will also examine the critical role of women, the recent global financial crisis and what lessons we have learned for the future.

Financial & Environmental Crisis

While we continue to try to climb up from the depths of a global financial crisis that started in 2007, the world knows that the game is not over. In the Eurozone it could all re-start next year. The recent downgrading of the US as a debtor nation for the first time in its history underscores these points. Yet within a historical context, the financial crisis takes a second place to the global threat to human survival that is developing in front of our eyes. We are in the midst of a global environmental crisis that started with the dawn of industrialization and was exacerbated by the Bretton Woods institutions that emerged after WWII to provide a financial infrastructure for international markets and to expand the role of markets across the world. Financial markets are implicated both in the financial crisis and in the environmental crisis, which are essentially two aspects of the same problem.

The popular media provides simple examples. In *The Times* article, “Marine Life Is Facing Mass Extinction,” we read:

The effects of overfishing, pollution and climate change are far worse than we thought.” The assessment of the International Program on the State of the Oceans (IPSO) suggests that a “deadly trio” of factors—climate change, pollution and overfishing—are acting together in ways that exacerbate individual impacts, and that “the health of the oceans is deteriorating far more rapidly than expected. Scientists predict that marine life could be on the brink of mass extinction. (Tuesday, June 21, 2011)

Observe that *all three causes* of extinction just mentioned—overfishing, pollution and climate change—are attributable to the industrialized world which consumes the majority of the marine life used as sea food, generates over 60% of the global emissions of carbon dioxide and uses 70% of the world’s energy, all of this while housing only 20% of the world’s population. Industrialization is at work in the impending destruction and mass extinction in the earth’s seas, the origin of life as we know it.

The complexity of the problem is baffling scientists. Normally the Earth self-regulates, but now we are tying the Earth’s hands, preventing it from self-regulating and therefore rescuing itself from the problem that industrialization has created. There is no

quick fix. The standard way that the planet regulates carbon, by sucking carbon from the atmosphere to maintain a balance, is by using its vegetation mass in land and seas, which breathes CO₂ and emits oxygen. Animals—humans included—do exactly the opposite, breathing oxygen and emit CO₂. In balance, the two sets of species—vegetation mass and animals—maintain a stable mix of CO₂ and oxygen. Since CO₂ in the atmosphere regulates its temperature, we had a stable climate. But the enormous use of energy by industrial societies is tipping the scales, preventing the planet from readjusting. On the same date, *The Times* finds that planting trees cannot really help² as their growth and carbon uptake are too slow, as explained in a recent Canadian report.³

Observe that it is not the developing nations with 80% of the world's population that are causing this problem. Over 70% of the energy used in the world today is used by 20% of the world population that lives in industrial nations, who emit 60% of the CO₂. These are the same industrial nations that created the Bretton Woods Institutions in 1945, which globalized financial markets, and that consumed since then the overwhelming majority of all the Earth's resources (Chichilnisky 1995, 1998).

The financial crisis and the environmental crisis are two sides of the same coin: they are at the foundation of the current model of economic growth in industrial nations with its voracious use of the Earth's resources. Both require a new model of economic growth. This opinion is shared by a recently created international group, the G20, the first world leading group of nations that includes developing countries, which met in Pittsburgh, PA, on September 24 – 25, 2009. Their Leader's Statement declares:

As we commit to implement a new, sustainable growth model, we should encourage work on measurement methods so as to better take into account the social and environmental dimensions of economic development...

Modernizing the international financial institutions and global development architecture is essential to our efforts to promote global

² "Planting trees does little to reduce global warming" (*The Times*, June 21, 2011, p. 17)

³ "Even if we were to plant trees in all the planet's arable land—an impossible scenario with the global population expected to rise to 9 billion this century—it would cancel out less than 10 percent of the warming predicted for this century from continuing to burn fossil fuels" (*The Times*, June 21, 2011).

financial stability, foster sustainable development, and lift the lives of the poorest...

Increasing clean and renewable energy supplies, improving energy efficiency, and promoting conservation are critical steps to protect our environment, promote sustainable growth and address the threat of climate change. Accelerated adoption of economically sound clean and renewable energy technology and energy efficiency measures diversifies our energy supplies and strengthens our energy security.

We share the overarching goal to promote a broader prosperity for our people through balanced growth within and across nations; through coherent economic, social, and environmental strategies; and through robust financial systems and effective international collaboration...

We have a responsibility to secure our future through sustainable consumption, production and use of resources that conserve our environment and address the challenge of climate change.

The G20 nations know the problems we face, but they don't know the solutions. For this, read on.

Green Capitalism

The task in front of us is nothing less than building a new foundation for the human future. In the midst of the 6th largest extinction on planet earth, facing potentially catastrophic climate change and extinction of marine life in the world's seas—the basis of life on Earth—we can fairly say that this qualifies as a global emergency. To find solutions we need to look closer at the root of the problem.

Bretton Woods: the World since WWII

A rapid expansion of international markets since WWII was led by the Bretton Woods Institutions and created an enormous consumption of resources. Industrialization is resource intensive, and was fueled by cheap resources from developing nations—forests, minerals, biodiversity. These resources were and continue to be exported at very low

prices. As a result, poverty in resource-exporting nations grew to constitute a ‘competitive advantage’ in the form of cheap labor and cheap resources, an advantage that has exacerbated and amplified resource overconsumption in the rich nations. Resources were over-extracted in poor nations who were desperate for export revenues, and they were over-consumed in industrial nations, thus leading to an ever expanding Global Wealth Divide. Indeed globalization since WWII increased together with an increasing Global Wealth Divide between rich and the poor nations, the North and the South (Chichilnisky 1994). The difference in wealth between the industrial and the developing nations grew three fold over this period of record industrialization and globalization. The global financial system that was created by the Bretton Woods Institutions in 1945, which is tied up with the financial crisis of the day, created this massive overuse of resources. Global financial institutions are tied up with the global environmental problems we face, and with the global wealth divide between the North and the South (Chichilnisky 1994).

Energy use goes hand in hand with economic progress, and most of the energy used in the world today is fossil (87%). For this reason, economic growth remains closely tied with carbon emissions. Industrial nations consume about 70% of the world’s energy, and the North-South wealth divide is inexorably connected to excessive carbon emissions that compromise the stability of the world’s climate.

The same North-South Divide is the main stumbling block in the United Nations Climate Negotiations. In the Convention of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), the leading problem is: Who should use the world resources? Who should decrease energy use and abate carbon emissions? The rich or the poor nations? (Chichilnisky and Heal 1994, Chichilnisky and Sheeran 2009)

It can be said that we are re-living last century’s Cold War conflict, but this time it is a conflict between China and the USA (Chichilnisky, *Time Magazine* 2009). Each could destroy the world as they are the largest emitters. China and the US by themselves could change the world’s climate. Each wants the other to reduce carbon emissions, namely “to disarm.” This time the conflict is not between the USA and USSR—it is between the rich nations represented by the USA and the poor nations represented by

China. The Gordian knot that must be cut is the link between natural resources, fossil energy and economic progress. Only clean energy can achieve this. But this requires changing a US \$55 trillion power plant infrastructure that produce electrical power around the world; 87% of world's energy is driven by fossil fuels, and power plants produce 45% of the global carbon emissions (International Energy Agency 2012).

How can we make a swift transition to renewable energy?

The Carbon Market

Energy is the mother of all markets. Everything is made with energy. Our food, our homes and our car, the toothpaste and the roads we use, the clothes we wear, the heating of our homes and offices, our medicines: everything. Changing the cost of energy, making dirty energy more expensive and undesirable and clean energy more profitable and desirable, changes everything. It makes the transition to clean energy possible. We have the technologies to produce clean energy, we just have to get the prices right. Is it possible to thus change the price of energy?

Yes, it is. Here is how. In 1997, after a long period of lobbying and design I wrote the structure of the carbon market into the Kyoto Protocol (Chichilnisky and Sheeran, 2009), which was voted by 160 nations and became international law in 2005. Today the Kyoto Protocol (KP) and its carbon market are been adopted as law by 195 nations, and four continents now have a Carbon Market. The carbon market changes the cost of energy the world over: it makes clean energy more profitable and desirable and dirty energy unprofitable. This changes all the prices of products and services in the world—since everything is made with energy—and it drives the economy to use cleaner rather than dirty energy sources. It is now more profitable and less costly to use clean energy and to reduce emissions of carbon now. Through the carbon market, the nations who over-emit compensate those who under-emit, and throughout the entire KP process the world's emissions remain always under a fixed emissions limit documented in Annex 1 (nation by nation emissions limits for OECD nations). A 'carbon price' emerges from trading the 'carbon credits' or rights to emit, which represents the monetary value of the

damage caused by each ton of CO₂. This corrects what has been called “the biggest externality in the history of humankind” (Stern 2006).

The carbon market cuts the Gordian knot and makes change possible. It makes clean energy more profitable and dirty energy less profitable. It encourages economic growth without environmental destruction: it fosters green development. The carbon market itself costs next to nothing to run.

What is the status of the Carbon Market of the Kyoto Protocol today? In 2011, at the Durban UN Convention of the Parties COP17, it was agreed to continue the Kyoto Protocol provisions to 2015 and to enlarge them to include the whole world by 2020. The EU Emissions Trading System is trading \$215 billion annually (World Bank 2005-2012), the carbon market’s Clean Development Mechanism transferred \$50 billion for clean energy projects to developing nations and there are mandatory carbon markets today in four continents, including Australia, Europe, Asia (Japan, China, India) and the Americas. The US already has already a mandatory carbon market in California since 2012; there is a carbon market for 10 Northeastern US States, called RGGI, and 22 other States are planning to create a Carbon Market of their own. Hundreds of cities and towns support the carbon market in the US.⁴ The economic incentives of the Kyoto Protocol’s carbon market are enormous. China reportedly created 1 million new jobs and became the world’s main exporter of clean technology equipment (sun and wind) after ratifying the Kyoto Protocol in 2005, and it benefitted from US \$30 billion from its carbon market and Clean Development Mechanism.

In the US, the 2012 emission limits placed by the EPA on newly built US power plants are likely to be extended to existing power plants, and this would mark the

⁴ In the fall of 2007, the US Supreme Court agreed that Federal government and the EPA can enforce carbon emissions limits without requiring Congressional approval, a decision that was tested and succeeded on March 27 2012 when the EPA established emissions limits for power plants in the US. Every effort to deem this regulation illegal by Republican representatives has failed so far. It is generally accepted that global businesses (for example the automobile industry) will benefit from KP’s guidelines, and could suffer economic losses without the benefit of KP economic incentives at home. This is because the automobile industry is global, and cars that do not sell in other OECD nations create huge losses and lead to bankruptcies. Since all OECD nations are buying carbon efficient cars, because they ratified the KP, the US car industry is commercially isolated. For these reasons, in 2010 the EPA imposed automobile emission limits (36.7 miles per gallon), an efficiency requirement that was increased further by the Obama administration in 2011.

beginning of a Federal Carbon Market in the US. A similar sequence of events took place when the Sulphur Dioxide (SO₂) market was created at the Chicago Board of Trade (CBOT) 20 years ago, considered a successful instrument in eradicating acid rain in USA. History is being written right now.

Green Markets—Transforming Capitalism in the 21st Century

What is a green market and why does it matter? A shining example of a green market is the Kyoto Protocol Carbon Market just discussed, introduced by the author. Another successful example is the SO₂ Market in Chicago Board of Trade. This is quite different from the carbon market because SO₂ concentration is not a “global commons” since it varies city by city while CO₂ is the same uniformly all over the planet. There are more green markets in the works. Today the UN is exploring markets mechanisms for biodiversity and for watersheds proposed by the author (Chichilnisky 2012). As with the carbon market, these new markets would trade rights to use the global commons—the world’s atmosphere, its bodies of water, its biodiversity—and therefore have a deep built-in link between efficiency and equity.

Efficiency with equity is what it’s all about. They are really two sides of the coin. One is equity and the other is efficiency. Both matter. The carbon market provides efficiency with equity. How? Through its Clean Development Mechanism (CDM), the Kyoto Protocol provides a link between rich and poor nations since poor nations do not have emissions limits under the KP and therefore cannot trade in the carbon market. But developing nations still benefit from the CDM of the carbon market. How so?

Developing nations have benefitted from the Kyoto Protocol (KP): since 2005, when it became international law, its carbon market funded US \$50 billion in clean technology (CDM) projects in poor nations (World Bank 2005-2012). Its CDM projects have decreased so far the equivalent of over 30% of EU emissions. The CDM works as follows. Private clean technology projects in the soil of a developing nation—China, Brazil, India—that are proven to decrease the emissions of carbon below a given ‘baseline’ are awarded “carbon credits.” These CDM carbon credits—by law—can be transformed into cash in the KP’s carbon market. This is how the carbon market provided US \$50 billion to developing nations since 2005 (World Bank 2005-2012).

Organizing Principles for Green Capitalism

Green capitalism is a way forward that is consistent with the evolution of existing institutions and curtails environmental degradation in industrial and developing nations. The basis was explained in Chichilnisky (2009, op. cit.). Here are three building blocks:

- (i) Efficient US Carbon Negative Technologies,
- (ii) The Kyoto Protocol carbon market and its CDM, and
- (iii) Global Capital Markets.

(i) Carbon Negative Power Plants for developing nations

There is enough residual heat in a coal power plant that it can be used to capture twice as much CO₂ as the plant emits, thus transforming the power plant into a ‘carbon sink.’ For example, a coal power plant that emits 1 million tons of CO₂ per year can become a sink absorbing a net amount of 1 million tons of CO₂ instead. This is a carbon negative technology. Carbon capture from air can be done anywhere and at any time, and so inexpensively that the CO₂ can be sold for industrial uses or enhanced oil recovery, a profitable opportunity (see www.globalthermostat.com). Renewable (solar) technology can power the process of carbon capture. This can help advance solar technology and make it more cost efficient. This means more energy and more jobs, and it also means economic growth in developing nations, all with less CO₂ in the atmosphere.

(ii) The Kyoto Protocol Carbon Market

The role of the Kyoto Protocol Carbon Market and its CDM is critical, as it can provide needed funding and financial incentives—about \$200 billion per year—for investment to build carbon negative power plants in developing nations in Latin America, Africa and Small Island States. The CDM can be used to provide “off takes,” which are contracts that promise to buy the electricity that is provided by carbon negative power plants for a number of years and therefore unlock banking resources for the investment.

(iii) The Green Power Fund: A US \$200 billion per year Private/Public Enterprise

The \$200 billion per year Green Power Fund was named and proposed by the author in writing to the US Department of State in Copenhagen COP on December 15, 2009, and published by the author in the *Financial Times* in 2009. Two days later it was publicly offered by US Secretary of State Hillary Clinton in the global negotiations COP 15 and subsequently voted partially by the nations at COP 16 as the Green Climate Fund. It is making the rounds in the negotiations in its complete form, where it has received substantial support.

As already mentioned, existing technologies (www.globalthermostat.com) can efficiently and profitably transform coal power plants and solar thermal sources of energy in a way that *reduces* atmospheric carbon concentration. Investment is needed to build carbon negative power plants in developing nations and elsewhere, to renovate the US \$55 trillion power plant industry infrastructure worldwide (IEA), which is 87% fossil fuels based today. What is required is about \$200 billion a year for 15 years. This amount of money will go to investment-grade power plant builders (e.g., General Electric, SSE, Siemens, Linde, etc.) to build carbon negative power plants in developing nations, which is exactly what the carbon market is trading today per year (US \$200 billion; see the World Bank's "State and Trends of the Carbon Market" 2010). Therefore the financial target proposed here is eminently achievable.

Blueprint for Sustainable Development

A blueprint emerges for Sustainable Development that is based on generally accepted aims:

1. Clean and Abundant Energy available worldwide
2. Sustainable growth in developing nations
3. Accelerating the transition to solar energy
4. Transforming fossil fuels into a clean alternative

Green Capitalism—Providing Traffic Lights for Human Survival

New types of markets are needed to transform capitalism by providing incentives that make green economic projects more profitable than their alternatives, fostering conservation of biodiversity, clean water, a safe atmosphere—and some of them already exist and are described above. Green markets change GDP by valuing the Global Commons (the atmosphere, biodiversity, clean water) and they also link equity with efficiency. Examples of green markets are:

1. Carbon Market—international law since 2005
2. SO₂ Market in US—trading at the CBOT since 1991
3. Biodiversity Markets for Water—to emerge, proposed by the author for United Nations consideration (Chichilnisky 2012)

Green markets provide the missing signal of scarcity that is normally provided by market prices when a good or service becomes very scarce. Such signals are tantamount to Traffic Lights for Human Survival.

Summary: A Vision for Sustainable Development

Avoiding extinction is about the survival of the human species. Survival is not about violent competition and struggle; it is about life, not death. Energy is the single largest source of carbon emissions and clean energy is the key to sustainable development. The carbon market creates the value system and prices that makes the transition possible. Carbon negative power plants are the future of energy, replacing the role of women as beasts of burden in poor nations, and creating green markets that change our value systems and lead the way to Green Capitalism. Women are the stewards of new values and a new economic system—Green Capitalism—based on public goods rather than increasing resource exploitation for private gain. They are key for sustainable development. The solutions proposed here can resolve the global climate negotiations and help overcome the global wealth divide, providing clean energy and economic growth for

the North and the South that is harmonious with the Earth's resources, and that is focused on creating and nurturing life on Earth.

Works Cited

- Arora, Vivek K., and Alvaro Montenegro (2011). "Small Temperature Benefits Provided By Realistic Afforestation Efforts." *Nature Geoscience* Vol. 4, 2011: 514–518.
- Chichilnisky, G. (1994). "North-South Trade and the Global Environment." *American Economic Review* Vol. 84, No. 4, Sept. 1994: 851-874.
- Chichilnisky, G. (1998). "The Economic Value of the Earth's Resources." *Trends in Ecology and Evolution* Vol. 11, Issue 3, March 1996: 135-140.
- Chichilnisky, G. (1995). "Biodiversity as Knowledge." *Proceedings of the National Academy of Sciences*, 1995.
- Chichilnisky, G. (2009). "Forward Trading: a proposal to End the Stalemate between the US and China on Climate Change." *Time Magazine* Special Issue of Heroes of the Environment. December 2009.
- Chichilnisky, G. (2012) "The Missing Signal." Prepared for the Summit of Ministers of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). See www.chichilnisky.com.
- Chichilnisky, G., and P. Eisenberger (2011). "Carbon Negative Power Plants." *CryoGas International*, May 2011: 36.
- Chichilnisky, G., and G. M. Heal (1994). "Who Should Abate Carbon Emissions?: An International Perspective." *Economics Letters* Vol. 44, 1994.
- Chichilnisky, G., and G. M. Heal, eds. (2000). *Environmental Markets: Equity and Efficiency*. Columbia University Press: New York, 2000.
- Chichilnisky, G., and K. Sheeran (2009). *Saving Kyoto*. New Holland: London UK 2009.
- International Energy Agency (2012). "Global Energy Sources by type of Power Plants, and Global Sources of CO2 emissions." www.IEA.com, 2012.

International Energy Agency (2012). “Electricity in a Climate Constrained World.” *IEA Report*, 2012.

G20 Leaders’ Statement from Meeting in Pittsburgh, USA, September 24 – 25, 2009:
<http://www.pittsburghsummit.gov/mediacenter/129639.htm>.

Stern, N. *The Economics of Climate Change: The Stern Report*. Oxford UK, 2006.

Swift, Jonathan (1729). “A Modest Proposal for preventing the Children of Poor People in Ireland from Being a Burden on their Parents or Country, and for Making them Beneficial to the Publick.” London UK, 1729.

The Times. “Marine Life Facing Mass Extinction.” Tuesday, June 21, 2011.

World Bank (2005-2012). “State and Trends of the Carbon Market” 2005-2012.
Washington, DC.

Youk, Hyun and Alexander van Oudenaarden (2010). “Microbiology: Altruistic Defense Needed for Survival.” *Nature* Vol. 467, Issue 7311. September 2, 2010.