



Science for Peace

# The Bulletin

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## A Tribute to Lee Lorch

Lee Lorch, a Science for Peace Board Member from the 90's until last year, died on February 28<sup>th</sup> at the age of 95. A wonderful obituary by David Margolick can be read here:

[http://www.nytimes.com/2014/03/02/nyregion/lee-lorch-](http://www.nytimes.com/2014/03/02/nyregion/lee-lorch-desegregation-activist-who-led-stuyvesant-town-effort-dies-at-98.html?src=twrhp&_r=1)

[desegregation-activist-who-led-stuyvesant-town-effort-dies-at-98.html?src=twrhp&\\_r=1](http://www.nytimes.com/2014/03/02/nyregion/lee-lorch-desegregation-activist-who-led-stuyvesant-town-effort-dies-at-98.html?src=twrhp&_r=1)

Rachel Deutsch also created a film on Lee Lorch's life which can be found on the Science for Peace YouTube channel at

<https://www.youtube.com/user/Science4Peace/videos> or via the direct link: <http://youtu.be/x3MKhuuMhE0>

There will be a memorial celebration for the late Lee Lorch in the [Winters College Dining Hall](#), York University, from 3:30 to 6:00 pm on Monday, June 23, 2014. This has been made possible by funding and sponsorship from the York University Faculty Association. To send your message of remembrance please email [leelorchmemorial@gmail.com](mailto:leelorchmemorial@gmail.com). Every effort will be made to have messages read out during the celebration. For more information, please contact: Martin Muldoon at [muldoon@yorku.ca](mailto:muldoon@yorku.ca).

## Some thoughts of farewell to my lifelong friend Lee Lorch by Chandler Davis

A fellow mathematician, a fellow militant in the defence of the Left in our native country the United States, and (when the U.S. cracked down on us) my predecessor in the transplantation to Canada.

Just a few of the many occasions on which he led the way.

In 1950, he had been ousted from two established faculties for his struggle against segregation at Stuyvesant Town in Manhattan, so prospective employers were nervous. Liberals were relieved that Lee, though already a notorious agitator, escaped a complete blacklist: he was hired by Fisk, a prominent historically black college in Nashville. Lee was not content to lie low. When the national mathematical establishment held a meeting in Nashville the following year, with a banquet at a whites-only hotel, Lee and three black colleagues showed up at the banquet, with tickets. The management turned them away, and the organizers didn't back them up, so they had to dine somewhere else that evening; but they appealed to the general mathematical public, and segregated sessions of the Mathematical Association of America were forbidden in later meetings. Some of us admired the action at the time, and I'm happy to report that the Association came around to honouring Lee officially for fomenting this progress, only 58 years later.

He personally recruited many women and minority students to mathematical careers - all his professional life, but especially during his five years at Fisk. Indeed, the population of black women math PhDs took a noticeable jump with Evelyn Boyd Granville, Vivienne Malone Mayes, and others Lee converted. When the New Left turbulence led to the formation of the Association for Women in Mathematics and the (primarily black) National Association of

Mathematicians, Lee was an original member and a loyal one.

In the mid-50s, he and Pete Seeger and I found ourselves in a select company: witnesses under indictment for contempt of Congress for refusing to answer before the US House Committee on Un-American Activities. Lee and Pete and I came through this pretty much intact, but the Committee collapsed in disgrace only a few years afterward.

Canadian mathematics has much to thank Lee for, but I'd like to mention a typical case that might be forgotten. In 1975, word got out that the military dictatorship in Uruguay had imprisoned one of the leaders of the former left coalition: Professor Jose Luis Massera, very well known in mathematics and a leader of the Communist Party. Massera was kept in solitary for many months, tortured, and kept almost incommunicado.

There were impressive world-wide protests by mathematicians, as you may imagine. As far as I know, the very first was the statement of the Council of the Canadian Mathematical Congress, initiated by Lee Lorch. I remember the sunny day in 1984 when Massera, newly freed from prison by the ending of military rule, attended the International Congress of Mathematicians in Berkeley, and buoyantly expressed his thanks to those who had supported him all those years--to none more happily than to Lee Lorch!

At a tribute to Lee twenty years ago at a math meeting, organized by three of us including his one-time student Vivienne Mayes, Lee responded to the praise with a gentle disclaimer: "The only thing that's special about me is that I'm very stubborn." Well, we knew what he meant: he often persisted when others wavered. Rather than stubborn, let's say DAUNTLESS.

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## Why the UofT Should Divest from Violations of International Law

*This article is a result of the collective efforts of Students Against Israeli Apartheid at the University of Toronto and the University of Toronto Graduate Students' Union Ad Hoc Committee on BDS.*

At the 2012 University of Toronto Graduate Students' Union (UTGSU) Annual General Meeting, members voted overwhelmingly in favor of a motion to call on the UofT to divest from companies benefitting from violations of international law and human rights abuses in occupied Palestine.

The motion states:

*Be it resolved that the Graduate Students Union endorse Palestinian civil society's 2005 call for boycotts, divestment and sanctions by calling on the University of Toronto to refrain from investing in all companies complicit in violations of international law. This includes any company that: profits from the illegal occupation of Palestinian land, directly benefits from the construction of the Wall and Israeli settlements, is economically active in settlements, and profits from the collective punishment of Palestinians. This would include the companies BAE Systems, Northrop Grumman, Lockheed Martin and Hewlett Packard.*

This motion came to the UTGSU six years after the call for Boycotts, Divestments, and Sanctions (BDS) came from Palestinian civil society. The request in that call was for the international community to engage with BDS tactics until Israel complies with International Law and universal principles of Human Rights. More than 170 Palestinian civil society organizations in the West Bank, Gaza, and the Diaspora signed on to the initial call, which took its inspiration from the struggle of South Africans and the role the international community played in boycotting and divesting from South African apartheid throughout the 1970s and 80s.

All people and organizations—including the University of Toronto—are bound by the principles of international law. This article demonstrates the ways in which Northrop Grumman, Hewlett Packard and Lockheed Martin, all companies that are part of UofT's investments, are complicit in violations of international law.

### Israel's Human Rights Abuses and Violations of International Law

#### **Israeli Settlements**

At the end of 2012, Jewish Israeli colonists lived in 121 Israeli-government officially recognized colonies in the West Bank, occupied East Jerusalem and the Golan Heights. As of July 2012, according to the Israeli Interior Ministry, 350,150 Jewish settlers live in officially recognized settlements in the West Bank, 300,000 in East Jerusalem, and 20,000 in the Golan Heights.

The settlements, in combination with the dozens of Israeli-only bypass roads that link them, as well as the military zones that surround them, have effectively annexed over 40 percent of West Bank land. Many settlements are built on prime agricultural land confiscated from Palestinians, or on land that sits above key water resources such as the Western Aquifer basin. They have also severely and disproportionately strained those resources: Israeli settlers consume 350 litres of

water per person a day, while Palestinians consume just 76 litres per day. The World Health Organization defines 100 litres per person as the minimum amount necessary for basic human health. Israel uses 83 percent of Palestinian water in the West Bank, leaving only 17 percent for Palestinians, who make up the majority of the occupied territory.

These colonies clearly violate two articles of the Fourth Geneva Convention; namely:

Article 49 which states: "...The Occupying Power shall not deport or transfer parts of its own civilian population in territory it occupies" and

Article 147 which defines acts that are considered to be "grave breaches" of international law. These include the "extensive destruction and appropriation of property, not justified by military necessity and carried out unlawfully and wantonly."

Additionally, United Nations Security Council Resolutions 446, 452, 465, and 471 all condemn Israel's settlement activity in the Occupied Palestinian Territories (OPT), including East Jerusalem. They confirm that the settlements have no legal validity and constitute a serious impediment to achieving a just and lasting peace. They also affirm that settlement construction is indeed a flagrant violation of the Fourth Geneva Convention, and they call upon Israel, as the Occupying Power, to comply with the Convention by refraining from changing the demographic composition of the Occupied Palestinian Territories by transferring parts of its population into the Territories.

### **Home Demolitions and Other Collective Punishment**

According to the Israeli Committee Against Home Demolitions, the Israeli government has destroyed 27,000 Palestinian homes and other structures (livestock pens and fences, crucial for livelihood) have been demolished in the Occupied Territories including East Jerusalem. Vast areas of cultivated land, hundreds of factories and other commercial properties, roads and public buildings have also been destroyed.

In addition to the homes Israel has destroyed, thousands of Palestinian homes have been ruined or significantly damaged by Israeli bombing or shelling. The UN Office for the Coordination of Humanitarian Affairs reports that during Israel's Operation 'Cast Lead' assault on Gaza from December 27, 2008 to January 18, 2009. "3,540 homes were destroyed in the course of hostilities, 2,870 homes were severely damaged and 52,900 homes sustained minor damage. Some 2,618 homes destroyed or damaged beyond repair during 'Cast Lead' await rebuilding, primarily due to the blockade and restrictions on the entry of construction materials through the Kerem Shalom crossing."

Israel's policies of home demolitions and other collective punishment again violate articles of the Fourth Geneva Convention; namely:

Article 33, which stipulates: "No protected person may be punished for an offence he or she has not personally committed. Collective penalties and likewise all measures of intimidation or of terrorism are prohibited...Reprisals against [the] protected and their property are prohibited."

### **Israel's Separation Wall, Checkpoints and Other Movement Restrictions**

The Separation Wall is a complex aggregation of fences, concrete, barbed wire, sensors, electronic devices, roads and towers extending over 720 kilometres long (five times the length of the Berlin Wall), 8 meters high and 60 meters wide. The Wall isolates dozens of Palestinian towns and villages from their farmland, encircles some of them completely with an entrance supervised by the Israeli military, and it severely hinders the movement of Palestinian civilians making education, medical treatment, trade and daily life very difficult, and often impossible. It annexes sixty per cent of the West Bank, sixty per cent of its water resources, and leaves the forty per cent of the remaining land dissected and broken into cantons.

Checkpoints and other obstacles to free movement restrict many of the main routes in the occupied West Bank, making travel to school, work, places of trade, or medical care extremely difficult, time-consuming, humiliating, and dangerous for Palestinians.

In June 2010, there were 505 closure obstacles throughout the West Bank. The obstacles include earth mounds, road gates, checkpoints, terminals, road barriers, roadblocks, partial checkpoints, trenches, and "flying" (surprise) checkpoints. The 65 permanent checkpoints "form the most severe restriction on movement of Palestinians, who are subjected to checks that often cause prolonged delays. At some checkpoints, soldiers bar all Palestinians from crossing except for those who have special permits."

The barriers have severely damaged the Palestinian economy, especially farming, tourism, and access to jobs. They also greatly impede Palestinians' ability to obtain proper medical treatment in several ways. For instance, Palestinians, including pregnant women, must get permits (which are valid only for a few days) to get to hospitals in East Jerusalem. In emergencies, this is often impossible. The Palestinian Red Cross recorded 440 delays and denials of ambulances in 2009 alone.

The 2004 advisory opinion of the International Court of Justice (ICJ) on the construction of the Wall in the OPT

confirmed that the Wall and its associated regime is contrary to international law. The ICJ ruled that Israel should immediately terminate its construction of the Wall, dismantle those parts that have already been built, and make reparations for all damages caused by its construction.

The ICJ specifically ruled that:

[a]ll States are under an obligation not to recognize the illegal situation resulting from the construction of the wall and not to render aid or assistance in maintaining the situation created by such construction. The Court further finds that it is for all States, while respecting the United Nations Charter and international law, to see to it that any impediment, resulting from the construction of the wall, in the exercise by the Palestinian people of its right to self-determination is brought to an end. In addition, all State parties to the Fourth Geneva Convention are under an obligation, while respecting the Charter and international law, to ensure compliance by Israel with international humanitarian law as embodied in that Convention.

Moreover, the International Court of Justice (ICJ) has ruled that Israel violates basic human rights by impeding liberty of movement and the inherent right to work, education, and adequate standard of living.

### **Wanton Killing, Detention and Inhumane Treatment of Civilians**

Since September 29, 2000, at least 6,862 Palestinians have been killed due to Israeli-government violence. Although some Palestinians have died during armed confrontation, many of the killings by the Israeli Defense Forces (IDF) were unlawful, and 1,523 victims have been children. Meanwhile, 54,761 Palestinians have been injured since 29 September 2000.

Currently 5023 prisoners are held in Israeli jails. According to the Adameer prisoner support organization, Israel has detained 800,000 Palestinians since 1967 representing twenty percent of the Occupied Territories and forty per cent of the total male population.

Palestinian prisoners are routinely ill-treated. Palestinians are housed in four interrogation centers, and three detention centers located in Israel proper, a violation of international law which stipulates that prisoners should be held in close connection. Palestinian prisoners can be interrogated for ninety days and can be denied visits from a lawyer for sixty days. Israeli treatment of prisoners includes physical and psychological torture including isolation and solitary confinement, tying prisoners in stress positions, sleep and sensory deprivation, and making threats against the lives of family members. Since September 29, 2000, 73 Palestinian detainees have died in custody due to torture.

Moreover, in the same period, approximately 8,000 children have been detained. Other breaches of international law consist of the use of Palestinians as "human shields" during IDF military operations.

The Israeli attack on the Gaza Strip which took place between 27 December 2008 and 19 January 2009 was also the scene of wanton killing and other inhumane treatment of civilians. The United Nations Human Rights Council (UNHRC) fact-finding mission to Gaza issued a report (which has come to be known as the "Goldstone Report") on 15 September 2009 concluding that the IDF had committed war crimes and possibly crimes against humanity. While the report condemned violations by both sides, it differentiated between the moral and legal severity of the violations of the Israeli forces compared to that of Hamas and other Palestinian armed groups.

The report maintained that Israel had deliberately targeted civilians and disputed Israel's claim that the Gaza war had been conducted as a response to rockets fired from the Gaza Strip, stating that the war was targeted against the "people of Gaza as a whole". It further stated that the assault on Gaza was designed to "humiliate and terrorize a civilian population." The report noted direct attacks on civilians, including some in which the IDF targeted civilians waving white flags. The report also concluded that Israel had committed a war crime for the "wanton" destruction of food production and water and sewage facilities.

The report of the United Nations fact-finding investigation surrounding the events in Gaza also concluded that the blockade of Gaza since 2007 has constituted a violation of Israel's obligations as an occupying power. The naval and land blockade Israel imposes on Gaza has been condemned by United Nations envoy Desmond Tutu, United Nations Human Rights Council Head Navi Pillay, the International Committee of the Red Cross as well as other human rights experts.

The torture and other cruel, inhuman or degrading treatment of civilians detained are so severe as to be considered "grave breaches" of the Fourth Geneva Convention and are thus legally punishable as war crimes. Article 14 of the Fourth Geneva Convention, for example, states: "Grave breaches...against persons or property protected by the present Convention [are]: willful killing, torture or inhuman treatment...unlawful deportation or transfer of unlawful confinement of a protected person."

### **How the UofT is Invested in these Violations**

The University of Toronto currently invests in three of the four companies listed in the UTGSU divestment motion. They are: Northrop Grumman, Lockheed Martin and Hewlett Packard.

Northrop Grumman is one of the largest weapons

manufacturers in the world, employing 120,000 people in 25 countries. The net sales of this US corporation, based out of Los Angeles, California, were \$24.6 billion in the 2013 fiscal year.

Northrop Grumman provides technology used by the Israeli military against Palestinian civilians, including technology that was used in Israel's 2008/09 "Operation Cast Lead" in the Gaza Strip, where, as discussed above, international agencies have concluded war crimes and possible crimes against humanity were carried out.

Northrop Grumman produces the fuselage, wings, tail, engine cowlings, canopies and avionics containers, as well as the optional Longbow mast-mounted 360° radar for the Apache AH64D Longbow Helicopter. Amnesty International has described the Apache AH64 Helicopters as a piece of "key equipment used by the IDF [Israeli military] in the Gaza bombing campaign."

Northrop Grumman also produces the Longbow Hellfire 2 missiles, in a joint venture with Lockheed Martin. The wide use of Hellfire 2 missiles by the Israeli military against Palestinian civilians during Operation Cast Lead has been clearly documented.

Northrop Grumman is also the sole provider of radars for the F-16 combat aircraft. The Israeli Air Forces (IAF) has the largest fleet of F-16's outside of the US. According to Amnesty International, Israel's F-16 combat aircraft played a central role in the killing of Palestinian civilians in Operation Cast Lead and the wholesale destruction of Palestinian civilian and economic infrastructure. However, this is not the first time F-16s have been implicated in Israeli violations of international law in the OPT. For instance, on 20 May 2007, an Israeli F-16 jet plane fired a missile towards a family gathered in Gaza City, killing eight people—none of them combatants.

Hewlett Packard (HP) is among the world's largest information technology (IT) companies, with revenues amounting to over \$112 billion for the 2013 fiscal year. Commonly known for its personal computing devices, printers, and digital cameras, HP is involved in a wide range of services including the design, implementation, and maintenance of IT infrastructure. HP operates in more than 170 countries, both under the HP label and through its various subsidiaries.

HP and its subsidiaries are involved in several aspects of the Israeli occupation of the West Bank and Gaza Strip. HP's most egregious practices include: providing the technology for the IDF checkpoint system, outsourcing IT systems to Israel's Settlements; managing the Israeli Navy's IT infrastructure, which enables them to continue the blockade of Gaza, and supplying the IDF with personal computers, servers, and virtualization systems.

Lockheed Martin currently stands as the world's number one military contractor and the largest arms exporter, receiving 84 percent of its revenue from the US government and the Pentagon. For both the US and other governments, Lockheed Martin has produced combat ships, fighter jets, missiles, nuclear weapons and military electronics.

Lockheed Martin is the largest overseas supplier for the Israeli armaments industry. One of its contracts with Israel includes manufacturing F-16 fighter aircrafts for the Israeli Defense Forces, estimated \$1.8 billion in value. This is an ongoing contract with the Israeli Defense Forces and Israeli Defense Industries, and is financed in part through U.S military aid to Israel.

Prior to the recent assault on Gaza and the boarding of aid ships en route to Gaza, former UN Secretary-General Kofi Annan had already condemned the IDF's use of American built military weapons, stating that hundreds of Palestinian civilians had been killed or injured in Israeli attacks, citing tanks deployed in refugee camps and explosives dropped on heavily populated areas. Following Operation Cast Lead in 2008/09, the use of F-16 fighter jets and Hellfire missiles was well documented as contributing to the more than 1,000 confirmed Palestinian civilian deaths. Organizations such as Human Rights Watch and Amnesty International have labeled such actions violations of human rights and insisted that they constitute war crimes, according to international law.

In March 2010, amid criticisms of Israel's continued housing construction in the occupied territories, the United States and Lockheed Martin signed a new agreement to provide Israel with several new Super Hercules tactical transport aircrafts. In a \$2.7 billion deal, Israel has recently purchased 20 new F-35 fighter jets from Lockheed Martin for delivery between 2015 and 2017.

### **Concluding Remarks**

The Nuremberg Principles I and II emphasize that individuals and organizations are responsible for complying with the principles of international law. Furthermore, Principle VII states that "complicity in the commission of a crime against peace, a war crime, or a crime against humanity. . . is a crime under international law."

Since the University of Toronto has a responsibility to comply with the principles of international law, it has a legal obligation not to invest in companies or organizations that may be complicit in the commission of these crimes. Indeed, the current investments held in the

three companies listed here strongly suggest that UofT is in violation of the Nuremberg Principles, thus rendering it potentially complicit in crimes under international law.

### **How to Get Involved**

If you would like to get involved the campaign to call for the University of Toronto to divest, or are interested to learn more, please contact Susanne Waldorf, Civics and Environment Commissioner at the UofT Graduate Students' Union at [civics@utgsu.ca](mailto:civics@utgsu.ca).

## **AGM 2014**

The Science for Peace Annual General Meeting 2014 will be held on June 14th at 1pm - 3pm in the South Dining Room of Hart House (7 Hart House Circle, Toronto, ON). All members who have paid their dues until that date are eligible to vote for Board members at the meeting. A Board Meeting is held immediately after the AGM to elect Executive Committee members. You can Skype or call into the meetings - please contact Bryan Eelhart, the Science for Peace Coordinator to arrange this: [sfp@physics.utoronto.ca](mailto:sfp@physics.utoronto.ca) or 416-978-3606.

## **The Wealth of Nature: Economics as if survival mattered**

**By John Michael Greer**

**New Society Publishers 2011 252pp. paper**

*Reviewed by Derek Paul*

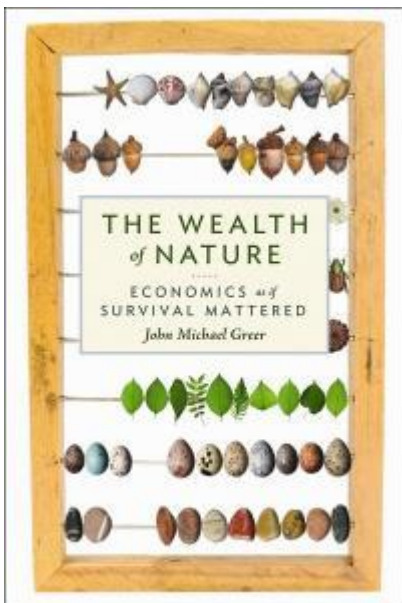
Publishing companies are in process of issuing a welcome stream of books based upon the realization that neoclassical economics cannot address the problem of climate change, and cannot address the problems of waste, consumerism, and the rising global ecological footprint. Currently the human race maximizes the throughput of resources from extraction to pollution subject only to the economic maxims of the moment such as, for example, "there isn't enough spending money just now to boost the economy." But climate change requires an end to fossil-fuel burning, the sooner the better, which runs exactly contrary to current industrial, economic and trading trends. For planetary health, material resources must be recycled to the maximum extent. But how does one proceed from here to there? Many

economists and environmentalists know the problem very well and few if any yet have a sufficient set of solutions on which to base a change. These solutions lie within the ways that resources will be handled (recycled), accounted and distributed, while at the same time the role of money must change. Money, that easily misunderstood human invention, will always remain with us, but must be there to serve and enable, and it cannot be allowed to dominate policymaking in any New Economy.

Greer, like all those before him writing from a position of renewed hope, has important insights to offer, and these should be duly noted, while his failures must also be enumerated.

The many virtues of this book include his attack on laissez-faire (in this he is not alone) pointing out again the many misconceptions in neoclassical economics that are currently driving civilization towards an early end. He makes many useful references to E. F. Schumacher, the famed author of *Small is Beautiful*, since Schumacher's principles will undoubtedly find a place in the field of a new model of economics that socially aware scholars are currently investigating.

Greer's first chapter, entitled "The Failure of Economics," contains much that we have seen before, but it is worth reading for anyone unfamiliar with the gross inappropriateness of the present system. Greer makes the point, from Schumacher, that one should distinguish between primary goods and secondary goods, the latter having been transformed by human industry or labour. It is already clear that in ecological economics primary resources must be conserved as much as possible. Greer refers also to natural capital, a most useful concept, but he would have done better to adopt the comprehensive capital scheme used by Canada's National Roundtable on the Environment and the Economy (NRTEE; c.2000) in which the researchers subdivided all capital into three categories: natural, built and human. This subdivision was important for the work NRTEE had in hand at the time, namely the construction of indices of wealth, to support future policy and planning. The fact that NRTEE nowhere used money as a measure of wealth fits nicely with some of Greer's other messages, in chapter 3.



Greer's second chapter is particularly useful, since it provides a framework for understanding the rapid current growth of inequity and, on the side, explains the gross inadequacy of GDP as a measure of prosperity. The GDP question has also received much attention from other authors. Greer subdivides the economy into three, depending upon whether it deals with primary resources (the first economy), processing of goods or services including investment in such activities (the second economy), and investment essentially in paper, where any value to people is at least at one remove from the first or second economies (the third economy). An example from the third economy would be derivatives, which are not direct investments in the first or second economies, and thus form part of the third economy. Part of the plight of ordinary people today living in formerly prosperous areas, the USA in particular, can be explained by the disproportionate amount of money in circulation that is going into the third economy. Great amounts of newly created money invested in the third economy are making some investment brokers very rich (in dollars) as well as some of their clients, but fail altogether to touch the mainstream of humanity, many of whom need employment, their families becoming poor amid a glut of goods. This destructive trend has worsened the already great imbalance in human equity, reducing the health of the whole, something any form of New Economics cannot allow to continue. It is a thorny problem to be faced since it challenges many of those earning the highest incomes.

Chapter 3 entitled "The Metaphysics of Money"

makes the central point that money isn't wealth, that all of us could have learned from NRTEE (see above) or from the *Book of Job*, since Job's wealth is nicely described at the outset and at the end, while money isn't mentioned, except in the last chapter, 42, verse 11, in which Job's brothers and sisters come to dine with him after his restoration to wealth, and each gives him a piece of money, a token to assuage his past suffering.

Wealth is in fact a vector, usually of many components. For an individual, some of the components of the vector might be: house, condo, antiques, art works, equipment, car, land, stocks in the first and second economies, stocks in the third economy, mortgages, bank balances, bonds. Only some of the last few of these must necessarily be stated in monetary terms, and the rest best stated in units natural to the entity in question. Those people who still hold the illusion that money and wealth are synonymous really need to grasp this point. Money is of no value when there is nothing available to purchase (and there have been enough sad examples of this in the world) and one's own currency is of no value when there is nothing to buy at home and the currency value has dropped out of sight relative to other, foreign currencies. As a final example, let's consider a large-diameter, tall, straight hardwood tree having a monetary value at any time as potential lumber but, whereas the money to purchase it can be created in a tiny fraction of a second, the tree, once cut, is gone and it would require at least eighty years to replace it. The distinction between money and wealth will be terribly important in the New Economy, and Greer does a fine job here.

In chapter 4, we find Greer at his weakest. Too many of his statements are unsupported, for example, his assertion that solar energy simply cannot replace coal power because it is too diffusely spread. His arguments fail because he has not envisaged the alternative to W, Bennett Lewis's dream of universally cheap energy. Greer furthermore avoids going into details; however, one must do so in order to make energy projections. For example, Greer describes the solar driven engine created by Frank Shuman in Egypt early in the 20<sup>th</sup> century. Research in this field needs extraordinarily close examination, including the exploration of many possible schemes, before a well-designed demonstrates that it has potentially wide use. This

search has by no means been completed. Already today there are patents applied for describing systems that contradict Greer's generality, though this does not, of course, establish any breakthrough.

Returning for one moment to W. Bennett Lewis's dream, one should ask today whether universally plentiful, cheap energy wasn't in fact the path to overconsumption and global pollution. Cheap energy in the United States has surely led to overconsumption, as has been shown by the profligate burning of oil since it became cheap. Nowhere in Greer's book is sufficiency distinguished from plenty; not does he anywhere critique the massive waste of oil still continuing today in his own country. His work concentrates on supply, and by failing to address demand, reveals a route to despair rather than one leading to a sustainable civilization.

Chapter five, entitled "The Appropriate Tools" goes into futuristic guesswork and as such is entertaining. It may point out truths we would do well to keep in mind, but readers should note that the future will bring surprises. Greer is surely right that the use of the least sophisticated tool that will do a given job will be much more emphasized as time goes on. Greer tends to jump from the massively expensive machinery of today back to manual work using simple hand tools, neglecting the possibilities and value of intermediate technology. For example, the owner of a small wood lot, wishing to cut lumber selectively from heavily forested areas, needs special, inexpensive equipment for bringing the logs out of the forest. Previously, teams of horses were used, and the method was one of brute force and inefficient use of energy. However, then the horses were there and could be used to fulfill such tasks. Today, horses as work animals have largely disappeared and they will not be returning in the same numbers. Therefore, we need to design something inexpensive to do these jobs easily with only one tiny tractor or a team of two men—or perhaps just one horse! Today's logging industry, equipped mainly for clear-cutting (itself a dubious process requiring massive capital expense), uses equipment more than ten times the cost of what a local selective cutter could afford. And it is the local selective cutter who can render his industry sustainable.

The same remark about futuristic guesswork applies to chapter 6, "The Road Ahead," and this chapter too contains many ideas we would do well to keep in mind. In the second paragraph, however, he interprets history as demonstrating that humans will retain their undesirable human qualities and thus our species will fail to cooperate in a manner needed to deal with current world problems. History, however, also teaches that humankind has often collaborated amazingly to defeat a common enemy even though such collaboration may have been a response to enemies in war. Surely, today there is an even more formidable threat from global warming. Once this phenomenon is seen as the common enemy, an amazing new level of cooperation might develop.

It is not clear that the human race is moving into an era of very expensive energy as Greer thinks but, if and when the price goes up, then a sensible pricing scheme will favour conservation and disfavour wastage. [In Ontario today, we have rising prices without a pricing scheme that favours conservation.] Greer doesn't refer even once to the global footprint news, one of the few sources of reliable numerical information on how we humans are doing in relation to resources and pollution. A smaller supply of energy and motivation to conserve are essentials in the way forward, not emphasized in the *Wealth of Nature*.

The need to replace oil burning (and coal burning) is ascribed unambiguously throughout the *Wealth of Nature* to "peak oil", however, the fact is that there isn't enough oil production as there was in 2005. But peak oil is irrelevant, except that its onset might prove a blessing as a warning call. The reasons that oil burning and coal burning must cease altogether are 1) so much is still available that burning them will drive the climate into uncontrollable warming, no longer restrainable by human action; and 2) that oil and coal are most precious resources for manufacturing, much needed for the future of the human race, so that oil and coal companies will make more total income, summed over the long term, if they reserve their resources for manufacturing.

The burning of fossil fuels will cause a major extinction if this appalling bad habit continues. According to David Wasdell, we have only sixty years to reduce such burning to zero [1]. The fact



that oil production has peaked is a mere coincidence, and is irrelevant to Greer's book.

*Derek Paul is Professor Emeritus, University of Toronto and a long-time member of Science for Peace.*

#### Note

1. David Wasdell's webcast from the September 2013 annual general meeting of the Club of Rome:

<https://onsync.digitalsamba.com/play/wasdell/14146-cor-dw-keynote>

## President's Corner: How to Save the World in a Hurry

by Metta Spencer

In the planet's history there have been five catastrophic extinctions of species. The biggest one, called "The Great Dying," happened 250 million years ago and destroyed 96 percent of all animal species in the oceans and 70 percent of all vertebrates living on land.<sup>i</sup> Many scientists attribute this to runaway global warming. Volcanoes in northern Russia spewed greenhouse gas and warmed the planet by 6 degrees. This melted methane hydrate crystals on the ocean floors, creating a vicious circle until the global temperature reached 15 degrees above normal. Not until ten millions years later did life recover. The UN is warning us to change course, lest the world's temperature increase 4 degrees during this century. The temperature threshold at which the methane clathrates will melt is unknown.<sup>ii</sup>

But this is not the only threat to humankind's survival. Here I'll review the most serious dangers and appraise some possible preventive measures.

The ancients believed that the world was composed of four elements: earth, air, fire, and water. We face calamities in all four, plus an additional one. We can't just pick one problem and leave the rest for later. We must address them all at together because they are interconnected, forming a single package. Although there may be millions useful actions we can take to help save the world, we have to start someplace. Where? I think the answer will come from treating these five issues as a single system.

To multi-task, it helps to "kill two birds with one stone." I have nothing against birds, but I think we need to kill five of them with one stone. Since all five issues affect each other, I look for solutions to one of them

with knock-on effects to help solve the others. Where we should begin saving the planet is with multi-purpose technological innovations—especially ones that are ready (say, within five years) to become massive projects. Let's look for specific projects that can be implemented rapidly on a huge scale, without any negative side effects, and that will help solve all the other problems at the same time. I have found only one thing so far that meets all those criteria. You'll be surprised to hear what it is.

### Five Existential Problems for Humankind

Here are the five problems that threaten human survival—the five "birds" that we want to kill with one stone.

**Earth** (Let's call it "Soil." The issue is not only its quantity but also its quality—its capacity to produce food and habitat.)

**Air** (Air contains our biggest problem: greenhouse gases that cause climate change.)

**Fire** (Let's call it by a more general term: "Energy")

**Water** (both fresh and seawater); plus one additional danger:

**Defence** (military preparations that supposedly make us more secure, but which often do the opposite.)

I like acronyms to help me remember lists, so here's the one I use: "W.A.D.E.S.", as in "My child *wades* in mud puddles for fun." This stands for: Water, Air, Defence, Energy, and Soil.

### Water Problems

People need *freshwater* for drinking, cooking, cleaning, manufacturing, and moistening agricultural soil. Less than 3 percent of Earth's water is fresh, including the almost 2% that's frozen in ice, less than 1% that's groundwater and soil moisture, and less than 0.01% that's in lakes and rivers.<sup>iii</sup> We are going to need more freshwater as our population grows to 10 billion, yet already the aquifers are being depleted faster than replenished. Rivers are drying up for the lack of melting snow packs. Freshwater is being poisoned by industry, mining, fracking, and farm chemicals. So our first challenge is to conserve freshwater.

Another water challenge involves the *oceans*, which are so deep that they make up 99 percent of the planet's living space. The seas are warming up. When sea turtles bury their eggs in the sand, instead of hatching the heat sometimes cooks them.<sup>iv</sup> Some marine species are

moving to cooler regions of the ocean, thus starving other creatures that depend on them for food. How can we stop the warming of oceans? By stopping the warming of the air. As I said, all five problems are connected.

Meanwhile, oxygen is declining in rivers and seas. There are 405 “dead zones” in oceans, the largest of which covers 70,000 square kilometres.<sup>v</sup> Marine life can’t survive there, partly because of the nitrogen and phosphorus fertilizer runoff from farms, which feed algal blooms. However, even the waters near Antarctica have lost about three percent of the oxygen in just the last decade.<sup>vi</sup> Fortunately, dead zones are reversible if the chemical runoff is halted. Here we see the connection between water problems and soil problems.

The ocean is also becoming more acidic. It had normally been slightly alkaline, but has become about 30 percent more acid in the past two centuries, today even dissolving the shells of oysters, lobsters, and corals.<sup>vii</sup> The acidity is in the top 100 metres of the ocean. When the surface meets the atmosphere, the carbon dioxide in the air dissolves as carbonic acid. Over the years, so much of it has dissolved that carbon is 140 times more concentrated in the ocean than in the air. Oceans have been a “sink” to contain excess carbon from the atmosphere but now they are saturated.

I guess the toughest bird to kill is the acidification of the oceans. None of the measures that I have explored seem capable reversing it quickly. Reducing carbon in the atmosphere will solve it within a century or two, but not within five years, which is our realistic time frame.

### Air Problems

Of the five big problems, you already know about one: the “greenhouse gases” in the air. The most worrisome gases are carbon dioxide, methane, which is what we use in our stoves, and nitrous oxide. About half of all global warming is caused by carbon dioxide.

At the dawn of civilization, the amount of atmospheric CO<sub>2</sub> was between 275 and 285 parts per million, but it started rising sharply at the beginning of the nineteenth century<sup>viii</sup> and in 2013 reached 400 ppm. Some scientists say that 350 parts per million is tolerable, while others say that CO<sub>2</sub> levels must not be allowed to exceed 320. Anyway, since we are now at 400 ppm, obviously we must not only prevent *future* emissions but remove some of the CO<sub>2</sub> that is already in the air.

Fortunately, there are methods for sucking carbon out of the air and either locking it away or recycling it as a valuable source of energy. You hear about *reducing*

*emissions* so much that I won’t focus on that but instead on *capturing and sequestering or reusing* the ambient carbon.

Did you know that fuel can be made from CO<sub>2</sub>? It can, and whenever we use it, instead of adding CO<sub>2</sub> to the air, we are actually eliminating some that is already there. Such a fuel is called “carbon negative.” It helps solve our energy problem while we solve our air problem—two birds with one stone.

### Defence Problems

If you are alarmed by climate change, you should also be frightened by military arsenals. You may consider weapons necessary for our security—useful tools for deterring foreign enemies who would attack if we didn’t have means of retaliating. We’re all supposed to believe that Canada has enemies, for otherwise why would our government plan to spend up to \$126 billion for new fighter planes?<sup>ix</sup>

But in many cases weapons have *negative* security value, for living with them is more dangerous than living without them. This is especially true of nuclear weapons. Military officers find them useless in real wars, for their only purpose is deterrence—to warn your potential enemy that if he strikes you with his nuclear missiles, you will immediately destroy his side. In order to make this threat credible, you cannot wait for his nukes to arrive and wipe you out. You must launch your own missiles as soon as you have been warned that his are en route.

But missiles are swift. Neither side can wait longer than ten or 15 minutes to verify that the other side’s missiles are on the way, so a nuclear war can begin by mistake. At least 13 times since 1962 nuclear weapons were nearly launched and researchers claim that the risks are still rising.<sup>x</sup>

I’ll mention one such event. A Soviet officer, Colonel Stanislav Petrov was in command of a bunker near Moscow in 1983 when NATO was holding war games in Europe. The radar began warning that nuclear missiles were en route, probably from Montana. Petrov was supposed to begin retaliating within 15 minutes, but he refused to do so, and thereby prevented World War III. Probably the false alarm was caused by clouds reflecting sunlight that looked like a missile’s plume. So Colonel Petrov saved the world! My friends and I sent him \$500 with our thanks.

Nevertheless, some governments still build nuclear weapons. For example, India has about 130 nuclear bombs and Pakistan about 100. They have fought three

wars and still threaten each other. If they ever use even half of them in a “limited” nuclear war, 22 million people will die from blast, acute radiation, and firestorms. Then a global famine will kill two billion more people within 10 years. This is because the bombs will explode over cities, creating black smoke that will cover the northern hemisphere and blot out the sun. Summer temperatures will stay below freezing and crops will not grow. Most of us will starve.<sup>xi</sup>

Do the Indian and Pakistani military leaders realize that they cannot use their nukes? If so, why do they want to keep them? I don’t know but our only means of security is to abolish every nuclear weapon on earth. That is my specialty. I figure that it’s pointless to solve climate change and prevent mass starvation if we let a handful of stubborn politicians blow up the world anyway.

And that could happen. There are still about 16,400 nuclear weapons on the planet, mostly owned by the US and Russia, with about 2,000 set to launch on warning. Each warhead is 7 to 85 times more powerful than the atomic bomb that destroyed Hiroshima.<sup>xii</sup>

By now, any nation or major terrorist group could build a nuclear weapon if they had fissile material. Fortunately, highly enriched uranium and plutonium are kept under guard. But every nuclear power plant in the world produces plutonium, and the more of it there is, the more accessible it is to thieves. Here we see the connection between two of our problems: energy and defence. It is questionable how long we can have nuclear power without also seeing nuclear weapons proliferate.

### Energy Problems

The only source of energy for early Homo Sapiens was food: about 2,000 daily calories per adult. By 100,000 years ago, they had discovered fire and their per capita use of energy had increased 2.5 times. Industrialization increased it more. By 1970 people consumed 115 times as much energy as primitive man.<sup>xiii</sup> Our own lifestyle uses vast amounts of fossil fuel—energy that plants produced by photosynthesis before the dinosaurs lived.

But gradually it has become harder to obtain such fuel. A few years ago people predicted that our fossil fuels would soon be exhausted. Fortunately (or perhaps unfortunately), new technologies — the tar sands, fracking, etc.— have made more oil and gas accessible, though with risks to the environment.

So the danger to humankind is not the *shortage* of these fuels but the fact that *using them* is so harmful. For example, there is plenty of natural gas, which is mainly

methane—a mixed blessing. If it leaks into the air, it is a far worse greenhouse gas than CO<sub>2</sub>, but if it is burned, it is only half as harmful a greenhouse gas as petroleum. Inevitably some of it leaks. Moreover, there are stupendous quantities of frozen methane. Permafrost contains methane in frozen soil or peat. The west Siberian bog alone contains methane equivalent to 1.7 trillion tons of CO<sub>2</sub>—more than humans have emitted in the past 200 years.<sup>xiv</sup> Clathrates are lattice-shaped chemical structures that trap or contain molecules. There are methane clathrates at the bottom of the Arctic ocean which can be mined, if other fuels are depleted. That would give us more time to change to sustainable fuel.

And we may need more time. By 2035, only 25 percent of the world’s fuel may come from sustainable sources. In the meantime, we have to choose between using fossil fuels that cause global warming and using expensive nuclear power, with its potential for more Chernobyls and Fukushimas, and its inevitable production of the essential ingredients for nuclear weapons. Again, we see links among three of our five problems—defence, energy, and air.

Arguments over energy are so emotional that long-standing friendships can break up over them. Perhaps that is why we avoid mentioning the worst danger: the possibility that the methane deposits may melt and speed up global warming, as happened in the Great Dying. Some permafrost and clathrates already are melting.<sup>xv</sup> You can set fire to water puddles in the Arctic because of the methane they contain. Scientists are uncertain, but they hope it will be fifty years before the stuff melts on a grand scale. The worst-case scenario is a giant burp—a huge bubble of methane emitted suddenly, in which case most or all animal species will become extinct. We must hurry.

### Soil Problems

This planet has about 13 billion hectares of land. About 5 billion of the hectares could, to some degree, be used for agriculture, but only 1.5 billion hectares are permanently cultivated. This is about one-third of the land suitable for crop production, so some land is still available. Land is unsuitable for farming if it has the following disadvantages: no source of fresh water; too hot; too cold; too rocky; too mountainous; too salty; too rainy; too snowy; too polluted; or too deficient in nutrients. Still, unsuitable land in deserts can be made arable again by reforestation and specific agricultural techniques.

The soil is a “sink” that can sequester carbon. Trees, especially, absorb CO<sub>2</sub> while they are still growing and retain it in their trunks until they die, when they rot or burn and release the stored-up carbon back into the

atmosphere. Reforestation is one of the most promising temporary ways of sequestering carbon. The soil holds carbon unless it is plowed, but tilling soil exposes the buried carbon to the air and lets it escape. For that reason, one important agricultural trend is the practice of “no-till farming,” whereby each seed is poked down into the soil by a drill. After the harvest, the residue can be left on the ground as a mulch instead of being plowed under.

Over time, much of the planet has desertified, partly because farmers have cut forests to obtain farmland, and partly because wild animals no longer graze in herds. Although vegetarians believe that the earth cannot produce meat for the large future populations, some environmentalists argue that well-managed herds of animals can make the deserts fertile again. They keep livestock in tight herds and move them from one paddock to another every few days. The animals stir up the soil a bit and leave their droppings as fertilizer before moving on. Rotating herds restores degraded pasture land.<sup>xvi</sup>

In any case, the growing human population will require more cropland. However well managed, this will reduce natural habitat and genetic diversity. The biologist E.O. Wilson expects that up to half of all existing species will become extinct during this century.<sup>xvii</sup>

The human population may reach 10.5 billion by 2050, when it will begin to decline again.<sup>xviii</sup> Unfortunately, the amount of food produced per capita may not keep up with this growth. The World Health Organization estimates that over 12% of all human beings are now malnourished. Yet even so, greenhouse gas emissions from farmland are increasing each year.<sup>xix</sup>

Where food production has kept up with population growth this has been done by irrigating and fertilizing the soil, and replacing human labor with heavy machines that burn fossil fuels. This kind of production is unsustainable. Phosphorus, necessary for fertilizer, is quickly being used up, while it is also being wasted, polluting rivers and oceans.<sup>xx</sup> Nitrous oxide emissions from fertilizers warm the atmosphere over 300 times as much as the same quantity of carbon dioxide.<sup>xxi</sup> Any real solution requires that fertilizers be used less, while food production increases.

Is this possible? It will become even harder when Arctic ice melts and the higher sea levels submerge land that is now farmed. Here we see that land, water, and air problems are all connected.

### Solving All Five Problems

I have named five big problems that will require a

technological revolution and mobilization of society in a crisis mode. Our survival is at stake, so let's strategize about how to achieve the following solutions:

- (a) **Water:** Let's reduce oceans' acidification and dead zones;
- (b) **Air:** Let's reduce greenhouse gas emissions and remove carbon that is already the air;
- (c) **Defence:** Let's disarm all expensive weapons that jeopardize humankind's survival;
- d) **Energy:** Let's produce energy from renewable sources;
- e) **Soil:** Let's protect land and restore degraded soil to productivity.

### Saving the oceans

To save the oceans, we must replenish the oxygen in their dead zones and reduce the carbon dioxide dissolved in their surface layer.

To restore the oxygen levels, we must stop pouring fertilizer down the rivers. How? By replacing much of the fertilizer with a cheap, abundant substance that is even better for the soil. This is charcoal, or as it is usually called today, “biochar.”

To reduce the acidity of the ocean, there are several possibilities, none of which is very promising. Some scientists want to pour lime or calcium bicarbonate into the seas, especially near coral reefs.<sup>xxii</sup> That would reduce the acidity locally, but not in the whole ocean.

A better innovation is the use of seaweed such as kelp as a source of ethanol, which can be mixed with gasoline or methane.<sup>xxiii</sup> It can replace fossil fuel without using the limited soil that is required for growing food. There's a special bacterium that ferments seaweed into biobutanol, which is better for cars than ethanol. If 2.5 percent of the US coastline were used for seaweed growth, 6.8 billion gallons of fuel could be produced in a year.<sup>xxiv</sup> (That would replace one-tenth of the gasoline that the US consumes now per year.<sup>xxv</sup>) This process could become a major industry within five years. Most vehicles may switch to electric power, but there probably will always be some need for liquid fuel, especially for airplanes. By using seaweed or CO<sub>2</sub> for fuel, we'll decrease ocean acidity a little, while also saving soil and producing energy without adding CO<sub>2</sub> to the air. That's four birds with one stone. Not bad!

Enter the US Navy. Fuel for the planes on aircraft carriers must be delivered by other ships, sometimes in hostile waters. However, some of those carriers are powered by nuclear reactors, and pretty soon they will be producing the fuel onboard for their planes, using

seawater. They use electrolysis to collect CO<sub>2</sub> and hydrogen separately from the seawater. Then they combine the two gases in the presence of a catalyst, making liquid airplane fuel.<sup>xxvi</sup>

Unfortunately, the electrolysis requires a lot of energy. Because the aircraft carriers have nuclear reactors, they can do this without emitting CO<sub>2</sub>, so the fuel is “carbon neutral.” Unfortunately, the process is inefficient. It uses more energy than it produces. It’s no solution to the energy problem, so it kills only two birds with one stone: water and air.

A civilian company in California also is producing methanol from seawater, using renewable energy. It is carbon neutral and less expensive than fuel made onboard ship. One expert calculated that this method can produce fuel for \$.79 per litre, and that it will remove CO<sub>2</sub> for the price of \$114 per tonne.<sup>xxvii</sup> That price is competitive with fossil fuels but regrettably the technology won’t be ready to scale up as fast as we need it.

### Saving the Air

Carbon can also be captured from the atmosphere, using three different methods. One scientist proposes to build “artificial trees” all around the world.<sup>xxviii</sup> Their “leaves” are like vertical Venetian blinds, coated with a resin that captures CO<sub>2</sub> from the air as it blows through. The CO<sub>2</sub> is removed, then buried or recycled to make methane, and the resin is re-used. Since CO<sub>2</sub> disperses all over the world, a molecule emitted in Timbuktu might be captured later in Buenos Aires or Shanghai.

It is more efficient to remove the CO<sub>2</sub> where it is concentrated, as from the flue of a fossil fuel-burning power plant. The CO<sub>2</sub> can then be made into methane or used to grow algae, which absorb huge amounts of carbon. Later, when squeezed, the algae’s oils can be made into airplane fuel. The whole cycle is carbon neutral, since the algae remove as much carbon, time after time, as the airplane engines emit.

### Saving the Soil

Now we come to my favorite way of removing carbon from the atmosphere while also enriching the soil. Tada! The winner is biochar. See, I said you’d be surprised! In the Amazon valley biochar exists in deep piles where it was deposited thousands of years ago. The Indians collected waste from their gardens and kitchens. They smoldered it in heaps covered with dirt, thereby limiting the presence of oxygen. The resulting charcoal was mixed with other materials such as pottery shards and buried, where it has kept CO<sub>2</sub> sequestered from the air ever since.<sup>xxix</sup>

Today machines produce biochar by “pyrolysis,” while also capturing the oils and gases for fuel.<sup>xxx</sup> It can be

made from any household or agricultural waste, such as corn stover, peanut shells, or the feathers, heads, and guts of poultry at a slaughterhouse. The biochar is then spread onto the soil, making it rich, black, and fertile. The biochar also retains moisture, restoring fertility even to degraded desert land. Plans are underway to revive parts of the Sahara desert to farmland, while slowing climate change.<sup>xxxi</sup>

Biochar helps solve all five of our existential problems. Five birds with one stone. Many other innovations help with one or two problems, and several of them can produce carbon-neutral fuel. Biochar, however, is truly carbon *negative*. It can remove CO<sub>2</sub> from the air and permanently sequester it. The technology is sufficiently advanced that it’s possible to begin making biochar and biofuels world-wide as a major industry within five years.

A 2009 report estimated conservatively that one gigatonne per year of carbon can be stored in biochar by 2030. (For comparison: the human use of fossil fuels now emits about 26 gigatonnes of CO<sub>2</sub> per year, so we still have to reduce that amount greatly.<sup>xxxii</sup>) But within a few more years, about five to nine gigatonnes of CO<sub>2</sub> per year can be captured. We’ll be growing more and better food at the same time, as well as reducing methane and nitrous oxide emissions, and improving the soil’s retention of water.

Since the authors of the report were only concerned with the sequestration of carbon, they did not even mention that biofuel is also produced during pyrolysis. However, other inventors are specializing in the fuel. Indeed, for \$27,000 you can buy a machine that produces clean energy at less than 10 cents a kilowatt hour.<sup>xxxiii</sup> Biochar is a win, win, win, win, win solution. It’s not magic, but it can help significantly.

**Water:** Biochar retains moisture in farmland so that it requires little or no irrigation.

**Air:** Biochar reduces the amount of carbon in the atmosphere and keeps it locked away for thousands of years.

**Energy:** Biochar produces oils and gases that can supplement other sources of energy.

**Soil:** Biochar restores the fertility of degraded soil, replacing fertilizer and enabling plants to grow larger and healthier than if grown with ordinary farming methods.

But saving the world will cost a lot. To pay for it we need to tax carbon everywhere in the world. I’m not suggesting *cap and trade*, but a direct *carbon tax*. It’s less bureaucratic and there are fewer ways to avoid it if you pay the tax at the pump.

But, you may ask: Did you forget **Defence**?

No, biochar can help with defence and security too, by providing the best conceivable reason to abolish dangerous weapons, which we need to do for our own security. Canada can save pots of cash by not purchasing \$125 billion worth of F35 fighter planes and the US can save \$640 billion over the next ten years by disarming its nuclear weapons.<sup>xxxiv</sup> Disarmament not only will make us safer, but will also cut the only item in the budget that's big enough. For example, I'd use some of the money for, say, pyrolyzing the billions of dead pines in the Rockies that beetles killed because winters have become too warm. If you have other ideas, fine. Promote your own way of saving the world instead. But promise me this: that you'll go push some politicians.

Yes, it's a political project. Every political party needs a coherent, comprehensive program. Take a comprehensive plan to the leaders of your political party and demand that they put it on their platform. We can kill five birds with one stone. Or, to use more uplifting

rhetoric, we can save this world. Let's do it within five years.

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- <sup>xxix</sup> To see a video of biochar being produced with homemade contemporary equipment, see this: <https://www.youtube.com/watch?v=RXMUmy8PpU>
- <sup>xxx</sup> See All Power Labs, <http://www.allpowerlabs.org/gasification/> This company produces gasifiers, which yield more gas than biochar. Alternative machines vary the output, depending primarily on the amount of heat applied.
- <sup>xxxi</sup> Pro Natura Newsletter, "Greening the Sahara with Biochar While Fighting Climate Change," <http://www.pronatura.org/wp-content/uploads/2012/03/Greening-the-Sahara-with-Biochar-2012.pdf>
- <sup>xxxii</sup> *Skeptical Science* <http://www.skepticalscience.com/human-co2-smaller-than-natural-emissions.htm>
- <sup>xxxiii</sup> Daniel Terdiman, "Carbon-negative energy, a reality at last—and Cheap Too!" *C/Neg* Oct. 19, 2013. <http://www.cnet.com/news/carbon-negative-energy-a-reality-at-last-and-cheap-too/>
- <sup>xxxiv</sup> Joe Cirincione "Exploding Budgets," *Time Magazine*, Oct. 10, 2012.. <http://nation.time.com/2012/10/10/exploding-budgets/>