

Seven steps to curb global warming

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Abstract

Based on best current estimates that the world needs to reduce global carbon dioxide emissions by 70% by 2050, and that there is at best a 10-year window of opportunity available to initiate the enormous changes needed, this paper proposes a set of seven self-contained steps that can be taken at a global level to tackle the problem with some prospect of success. The steps are self-financing and practicable, in that they are based on existing technologies. They involve agreement to create a new international agency charged with formulating and policing a global carbon pricing regime; a complementary step involving global monitoring of greenhouse gas emissions utilizing satellite resources; taking steps to compensate developing countries for preserving rainforest as carbon sinks; the dismantling of newly created trade barriers holding back global trade in biofuels; global promotion of a transition to renewable sources of electricity through facilitation of grid interconnections with independent power producers; a global moratorium on the building of new coal-fired power stations; and recycling of carbon revenues to promote uptake of renewable energy sources in developing countries, particularly Brazil, India and China. Taken as a group, it is argued that these steps are both necessary and sufficient. They call for institutional innovations at a global level that are politically difficult but feasible, given the magnitude of the problems addressed.

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1. Introduction

There is a dawning awareness in 2007 that Planet Earth faces a crisis of unprecedented magnitude due to climate change, and that there is at most one or two decades within which major changes can be set in train to reduce emissions of greenhouse gases—mainly carbon dioxide produced from the burning of fossil fuels. There seems to be a growing consensus that if major changes are not set in place by 2020, and are having the effect of actually driving down GHG emissions, then the planet faces a man-made catastrophe. The most recent authoritative statement on the topic, by the Intergovernmental Panel on Climate Change, adopted in Paris at the beginning of February 2007, is clear: ‘Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic

greenhouse gas concentrations’—where very likely is taken to mean with 90% probability.¹ Most informed observers are now coming around to the view that the debate over whether climate change is caused by humans is settled; the issue now is what is to be done about it. The role of carbon dioxide emissions from industrial activities and transport is now clear, and it is understood that the levels of emissions have to be reduced. More specifically, and based on the latest evidence, Tim Flannery states in his widely admired book on global warming, *The Weather Makers*, ‘The best evidence indicates that we need to reduce our CO₂ emissions by 70% by 2050.’²

So what realistically can be done, at a global level, to drive down the level of man-made greenhouse gases, starting with carbon dioxide?

¹IPCC (2007): Intergovernmental Panel on Climate Change, Fourth Assessment Report, ‘Climate Change 2007: The physical basis’, Summary for Policy Makers, p. 10. Available at: <http://www.ipcc.ch/SPM2feb07.pdf>.

²See Flannery (2005) at p. 6.

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In this article I propose seven steps that call for interventions at a global level. The seven steps are proposed as a package, in the sense that they would be necessary and sufficient to set in train the processes that would really solve the problem. They do not call for any heroic technological assumptions, but they do demand institutional innovation at the global level—but practical institutional innovation that builds on past experience. The proposals are self-financing, and are designed to complement initiatives that are already being taken at national and sub-national level. It is unavoidable that the greatest global crisis yet encountered will call for unprecedented global initiatives. This is my listing, designed to trigger debate on this all-important topic.

I do not discount initiatives that may be taken at national or sub-national levels, of which there are several that clearly move in the right direction. Worth mentioning are the initiatives in California where Governor Arnold Schwarzenegger recently issued Executive Order establishing targets for the use and production of biofuels, which are mandated to replace 20% of fuels by 2010 and 40% by 2020.³ The case of Sweden is also of interest, where the Commission on Oil Independence in Sweden issued its report in 2006 showing how it believed Sweden could become effectively oil-independent by the year 2020; the Commission recommended drastic increases in biofuels drawn from ‘forest and field’ in Sweden itself, as well as big pushes behind energy efficiency, particularly in the industrial sector, and combined heat and power for heating of houses. The Swedish initiative builds on years of experience in the Nordic countries of taxing carbon-based energy activities, to the extent that these have become the major source of tax revenue, and have been very effective in reducing carbon-based activities.⁴ A third case would be the Biodiesel program in Brazil, launched in 2005, which has the goal of introducing cleaner-burning biodiesel as a B2 blend by 2008 and a B5 blend by 2013 at the latest (and possibly as early as 2010) backed by a nationwide program to ensure fuel quality, fuel outlets and distribution, and the promotion of a variety of feedstocks in the form of oilseeds grown in the impoverished northeast of the country and providing work for upwards of 100,000 rural workers within the first 18 months of the program.⁵ These and several such programs show that governments at national and state level are indeed capable of taking the kinds of initiatives needed.

But what about the global initiatives needed for a global problem?

Two programs are currently in place, under different UN conventions. The first and oldest, the Intergovernmental Panel on Climate Change (IPCC), provides the framework within which successive scientific reports on global warming have been produced.⁶ The IPCC draws together the world’s climate scientists and has assumed responsibility for producing a series of peer-reviewed reports that express a global scientific consensus on the character of global warming. These reports, the fourth of which is to be issued in 2007, carry an authority unmatched by any other global climate or atmospheric science organization; the IPCC reports and the process for producing them remains as the rock-solid foundation of any global efforts to combat global warming. The IPCC provides a sound formulation of the problem—but does not provide the solution.⁷

The other global initiative is the UN Framework Convention on Climate Change (UNFCCC), adopted at the Rio Earth Summit in 1992 and in particular the Kyoto Protocol, targeted at direct reductions in emissions of CO₂, as adopted at the Kyoto conference of 1997. Under the UNFCCC there have been successive ‘Conferences of the Parties’ (COPs) of which Kyoto was the third. The Kyoto protocol opened for signature in 2002 and came into force in 2005 when Russia finally agreed to join the international effort.⁸ As is well known, the US in 2001 refused to ratify the Kyoto protocol, in line with the Senate’s Byrd-Hagel resolution to the effect that the United States should not be a signatory to any protocol that did not include binding targets and timetables for developing as well as industrialized nations. The Kyoto protocol leaves developing countries out of the picture, at least initially, opening the way for the US to use this as an excuse to absent itself from the process. This leaves the world’s two largest producers of GHGs, the US and China, out of the Kyoto process. Subsequent Conference of the Parties meetings held at Bonn (COP6) in July 2001 and at Marrakech in October–November 2001 (COP7) further elaborated on the mechanisms by which countries would commit to reductions in carbon emissions but also opened numerous loopholes, particularly in the treatment of carbon sinks. The result is that even the most optimistic observers do not see Kyoto on its own as leading to a significant reduction in GHG emissions.

The Kyoto protocol is thus, as even its most fervent admirers recognize, a flawed process.⁹ It is based on

³The Low-Carbon Fuel Standard is discussed in a White Paper issued from the Governor’s office in February 2007; see: <http://gov.ca.gov/index.php?press-release/5074/>.

⁴Nordic Council of Ministers, “The use of economic instruments in Nordic and Baltic environmental policy 2001–2005”, September 2006, available at: <http://www.norden.org/pub/miljo/ekonomi/sk/TN2006525.pdf>.

⁵See “Brazil’s biodiesel program may have found its way” June 2006: <http://www.planetark.com/avantgo/dailynewsstory.cfm?newsid=36922>.

⁶The Intergovernmental Panel on Climate Change was established in 1988 by two UN organizations, the World Meteorological Office and the UN Environment Program. For background, see the IPCC website: <http://www.ipcc.ch/index.html>.

⁷The IPCC Working Group III produces reports on ‘Mitigation of climate change’—meaning steps to be taken to curb GHG emissions; while Working group II produces reports on “Impacts, Adaptation and Vulnerability”. However the IPCC does not see its mandate as recommending the kind of institutional innovations to be discussed in this paper.

⁸For background on the UNFCCC and Kyoto Protocol, see the UNFCCC website: http://unfccc.int/kyoto_protocol/items/2830.php.

⁹Nordhaus (2001b) probably speaks for many when he observes that “the major merit of the new accord [Kyoto Protocol] is that it is the first

mandatory targets for emission reductions and a ‘cap and trade’ international system that translates domestic experience in the US with sulfur dioxide emissions into the international realm, where provisions for ensuring validity of reporting and validity of enforcement are deficient. The emissions trading systems (ETS) to implement Kyoto are having a great deal of difficulty in getting started, and the European ETS has still to build credibility. There is little sign of commitment even from participating countries (with the possible exception of Japan). There is widespread agreement that the design of the Kyoto Protocol is flawed, in that it is focused on short-term targets; is inflexible in the quantitative targets set without reference to costs incurred; and has a poor capacity to build further towards a more activist coalition.¹⁰ The developing countries, led by Brazil, India and China, are left out of the Kyoto process, at least in its first round—while it is widely agreed that they will be contributing GHG emissions on a large scale themselves by 2020. So the Kyoto process provides a beginning to a solution at a global level, but not a solution that will drive down greenhouse gas emissions far enough or fast enough to solve the climate problem.

There is abundant scope, then, indeed necessity, for thinking afresh about what a ‘post-Kyoto’ global approach to directly targeting CO₂ emissions might look like, utilizing a sharp, globally mandated regulatory instrument. This will in effect be a third global stream, complementing the streams already underway through the IPCC and the UNFCCC. This third stream must not cut across Kyoto, but must be independent of it and go well beyond it if global warming is to be curbed.

Actually there is no need to wait for further clarification of either technological or economic advances. The steps that need to be taken are well understood and analyzed. Economically it is now well understood that the most efficient means for bringing about reductions in CO₂ reductions involve a hybrid system of carbon taxes and permits, and the approaches to reducing fossil fuel usage and enhancing uptake of renewable energies and fuels is likewise well known. The issue is to set these policies within the appropriate global institutional innovations that would make them practicable.

(footnote continued)

experiment with market instruments in a truly global environmental agreement” (2001, p. 1284). Nordhaus describes the accord as an instance of “institutional innovation” in an area where “there are no mechanisms for dealing with economic global public goods like global warming” and as such, it is “a useful if expensive guinea pig” (2001, p. 1284). Kyoto is from this perspective a first step towards dealing with global warming, but certainly not the last.

¹⁰McKibbin and Wilcoxon (2004) suggest that “the likelihood that the Kyoto Protocol will achieve significant real reductions in greenhouse gas emissions is very low” (2004, p. 467). Böhringer (2002) and Victor (2004) place the deficiencies of the protocol in a political setting, while Barrett (2002; 2005) draws attention to the flaws in the political design of the Kyoto Protocol. The upshot is that Kyoto is no longer capable of bringing about the climate changes needed, even if the US were to re-enter the process. Hence the argument that a fresh start is needed.

2. Seven steps: a self-contained package

A viable package of initiatives, or steps, that would actually reduce emissions by 70% by 2050, would consist of the following known and well-studied measures. First, and the driving force behind the package, would be a global regime that puts an effective price on carbon, forcing all economic actors to take into account the costs of emitting carbon and forcing them to consider how such costs could be mitigated by investing in measures to reduce the emissions. What is proposed is a hybrid scheme that brings together the best elements of a carbon tax and a cap and trade scheme, implemented at the national level but coordinated through international agreement. A second, complementary step involves establishing a global monitoring system for measuring GHG emissions, utilizing satellite monitoring, and creating the international agency charged with this responsibility. A third step compensates tropical developing countries for preserving rainforest as an important carbon sink. A fourth step involves the dismantling of newly created trade barriers holding back global trade in biofuels, which could substitute eventually for a large proportion of petrofuels used in transport. A fifth step would call for global promotion of a transition to renewable sources of electricity through measures such as facilitation of grid interconnections with independent power producers (IPPs), and again a mechanism for global monitoring of such initiatives. A sixth step would address the single biggest contributor to global warming, namely the building of new coal-fired power stations, and call for a moratorium on such constructions (amounting to an infinite carbon tax). And a final step brings the package together by recycling of carbon revenues to promote uptake of renewable energy sources in developing countries, particularly Brazil, India and China; the proposed international carbon pricing authority (ICPA) could raise such revenues by issuing bonds in its own name, just as is done by the World Bank and other credible institutions.

2.1. Step one: a global carbon pricing regime

The first step needed at a global level is an effective and market-driven system to reduce carbon emissions—*really* reduce them. We know how it can be done. What is needed is a system that imposes a tax on carbon emissions, ratified by a global treaty and enforced by a newly created global authority, preferably one that operates outside of the UN system that gave us Kyoto. A tax on carbon emissions sheets home the problem to where it originates, making the polluters pay. But a tax also has its drawbacks, such as its falling most heavily on the most entrenched carbon emitters, giving them few political options other than to oppose it—which they have done very effectively for the past decade, and would no doubt continue to do so. So let us combine the tax with a permit system, under which tradeable permits can be allocated to the most intensive carbon emitters (at less than their current output). The tax

in such a system can be imposed in the form of short-term permits (STPs) that have to be bought from the government, to make up any deficit in carbon permits over carbon emissions.

The proposed hybrid scheme that combines a system of carbon permits with a tax at the margin achieved through the sale of short-term carbon permits, is what the world needs now to get past the Kyoto roadblock. It gets around the endless debates over whether quantitative or price-guided targets are preferred.¹¹ The answer is: both are needed. This is the basis for a hybrid scheme that has been proposed and analyzed for a decade now by scholars such as McKibbin and Wilcoxon; Pizer; Aldy, Orszag and Joseph Stiglitz.¹²

As expounded by McKibbin and Wilcoxon over the past decade, such a hybrid scheme establishes a system where carbon emissions have to be matched by carbon emission permits, where adjustments at the margin reflect the prevailing price of carbon.¹³ The scheme has three core elements: (1) a system of long-term permits (LTPs) to emit one metric ton of carbon per year that can be allocated in any way seen fit to the carbon emitters in a country, and henceforth can be traded in perpetuity; (2) a system of STPs, say annual permits to emit one ton of carbon, that can be sold by the government for a set 'trigger' price and are valid only for the specified short-term; and (3) an enforcement mechanism whereby emitters of carbon within the country concerned must have permits (both LTPs and STPs) that match their emissions. Effectively these three elements put an economy on a carbon-price footing, and force emitters to take the price of carbon into all their investment decisions. But it does so in a way that enrolls carbon emitters as supporters of the scheme, by allocating the LTPs to them at the outset (always at a level that forces them to reduce emissions or purchase STPs to cover the shortfall). The sale of STPs acts effectively like a carbon tax at the margin, generating fiscal revenue for the government and setting a cap on the costs of adjustment for emitters.

A hybrid scheme of the type proposed has the advantage of being national in scope, so that tradeable permits have

an origin that is subject to national jurisdiction and control with the national government implementing it in such a way that it conforms to the country's legal and institutional endowments. This is its huge advantage over the Kyoto system where permits can be created internationally from notional entitlements, such as Russian 'hot air' arising from its emissions in the mid-1990s being below its 1990 levels. But if the hybrid scheme is ever to get off the ground in time to save the planet, the details of the scheme will clearly need to be settled at an international conference and then implemented in a coordinated way. The key to coordination lies in adopting a common price for the STPs, not so that they can be traded internationally, but so that the scheme imposes equal efficiencies on each economy, and so does not create windfall profits from trade.

Let us assume that sufficient political will can be mustered by the world's leading countries, led by the United States, to tackle the problem of global warming directly and finally. (We discuss some possible practical steps below.) The world's international community would sign up for the hybrid carbon pricing scheme, and as each country ratifies the treaty, it would commit to implement the dual permit system and impose the requirement that carbon emitters match their emissions with permits. The revenues from short-term permit sales (i.e. the marginal carbon tax) would be collected by each ratifying country's finance or tax authority, and administered according to national law. The first impact of such a step would be to bring transparency to each country's tax regime, and clarify where taxes are already falling on carbon activities (e.g. in fuel excise taxes) and what would be the extent of the 'gap' that would have to be made up by new sales of STPs. Whether the fiscal revenue from such permit sales be offset by reductions in tax burdens elsewhere (particularly off income taxes, so swinging the tax system of the country away from productive work and towards the taxing of destructive behavior) would be a matter for each individual country.¹⁴ We know how carbon taxes work, because they have been implemented in the Nordic countries over many years, and have been extremely effective in changing industrial behavior and reducing carbon emissions.¹⁵

¹¹There is an extensive literature on the topic of a quantitative target system, like Kyoto, versus a price-oriented system such as a tax regime. See Baranzini et al (2000), Pezzey (2003) or Hovi and Holtmark (2006) for relevant discussion; and Weitzman (1974) and Roberts and Spence (1976) for early and original contributions to the debate.

¹²See McKibbin and Wilcoxon (2002); Pizer (2002); and Aldy et al. (2001) for fundamental discussions of the hybrid approach and its efficiencies. Other contributors to the idea include Kopp et al. (1997, 1999); and Pezzey et al. (2006). The sale of short-term permits can also be likened to the operation of a 'safety valve' and in this guise is discussed by, e.g. Morgenstern (2004). Aldy, Barrett and Stavins (2003) discuss the hybrid approach and contrast it with other global climate policy architectures.

¹³The Blueprint was first expounded by McKibbin and Wilcoxon (1997) and has been elaborated in subsequent Brookings Institution papers and books, as in McKibbin and Wilcoxon (2002, 2004) and most recently in a detailed comparison between Kyoto and the Blueprint in McKibbin and Wilcoxon (2006).

¹⁴Former Vice-President Al Gore proposed in September 2006 that the US switch from taxing employment to taxing pollution (effectively, a carbon tax). See: <http://www.planetark.org/avantgo/dailynewsstory.cfm?newsid=38151>.

¹⁵See the report by the Nordic Council of Ministers, *op cit.* and the paper by Bruvoli and Larsen (2004) for discussion of the effectiveness of Nordic carbon taxes. For discussion of carbon taxes in general, see Pearce (1991); Cooper (1998); Nordhaus (2001a, b); Zhang and Baranzini (2004); Gerlagh and Lise (2005); and most recently, Green et al. (2006). The impact of carbon taxes has been explored through simulation in an extensive literature; see Wagner and Sathaye (2006) for a recent contribution, and Gerlagh and van der Zwaan (2006) for a treatment that compares different policy instruments, and finds that across numerous simulations, the recycling of carbon tax revenues to support renewable energy deployment is an optimal approach—thus lending support to the arguments presented here.

The virtues of such a system are that it would be seen as practicable and efficient, in that it requires no major institutional change at the level of participating countries, and since it prices emissions in the degree to which they contain carbon, it efficiently targets the main sources of GHG emissions. Since we are talking about fiscal revenues, rather than an environmental standard, the full force of state fiscal machinery will be utilized by all countries in the implementation of the GHG-curbing measure.¹⁶ The tax will fall most heavily on coal-burning industries, and then on oil-burning industries, and it will have the effect of driving them to change their energy calculations. But if the LTPs are allocated to the coal industry (say in a 40, 40, 20 mix, with 40% going to the companies as permits in perpetuity; 40% going to them as 5-year entitlements; and 20% being distributed to households in the country to act as a reserve force always interested in maintaining the value of their permits) then the permits act as financial compensation for having to wear the cost of carbon pricing, and rewards workers in the industry for their past sacrifices to the mining industry rather than penalizing them with a new tax. The necessity to buy STPs to cover shortfalls will drive industries to become more energy efficient. The virtue of such a hybrid system is that it does not call for the arbitrary creation of limits or quotas, and yet brings about the same effect, through creating economic incentives. Its virtue lies also in the fact that it will not call for arbitrary transfers of huge sums, involving tens of billions of dollars, to countries that have not actually done anything to reduce GHG emissions, such as Russia (which is one of the unfortunate implications of the Kyoto 'cap and trade' system and its 1990 benchmark).¹⁷

The global carbon pricing scheme would have to be qualified to ensure it meets its targets. Exemptions would be given to producers and users of biofuels, since the carbon emissions in this case merely replace carbon drawn from the atmosphere while the plants were growing; it would be perverse to allow a global carbon pricing scheme to stand as a barrier to the uptake of biofuels. Developing countries could be integrated in such a global carbon pricing regime through incremental steps, with perhaps a threshold per capita income of, say, \$5000, required to

bring the country in as a participant.¹⁸ In this way the global carbon price would fall on everyone, but in a manner that reflects ability to pay.¹⁹

The international treaty would establish a new international agency which would be empowered to set the price of STPs (i.e. effectively the tax level), and monitor its implementation, country by country. This new agency would rapidly come to be viewed worldwide as the 'conscience' of the planet in cleaning up the mess created by high-carbon economies. Let us propose that the price be set by international agreement initially at a level of \$10 per ton of carbon. This is a rather modest level, and would yield a total maximum take, based on current emissions of carbon of around 7 billion tonnes a year (equivalent to ~25 billion tonnes of carbon dioxide) of \$70 billion per year.²⁰ But at the same time the scheme thus sets an upper bound on the costs of conversion for high carbon emitters of \$10 per ton, since they can always buy permits at this level if they have emissions outstanding. The price would no doubt be raised sequentially, by international agreement, through 5-yearly gatherings under the auspices of the international carbon pricing treaty and its designated authority. The fiscal revenues collected by national governments could then be recycled to create incentives for the shift to renewable energy sources.²¹ The treaty might also specify that countries allocate, say, 1% of the fiscal takings back to the international authority, to underwrite its expenses and create a fund for allocation to initiatives that need a global push, such as global monitoring of GHG emissions (see Step Two) or development of global standards for vehicle fuel emissions and fuel efficiency standards, or to create incentives for developing countries to move to fossil fuel-independent energy trajectories (Step Seven). This fund would stand initially at \$700 million per year, and would augment existing funds for promotion of renewable energy technologies in developing countries, such as the Global Environment Facility of the World Bank, which had funds under management of \$1.8 billion in 2006. If progress

¹⁸In 2005, there were 103 countries with GDP per capita (PPP) exceeding \$5000, and 78 countries with income below this level, according to the IMF *World Economic Outlook* database.

¹⁹In this sense the proposed global carbon tax would satisfy demands that a global solution should meet equity as well as efficiency criteria—and as such would satisfy principles of 'Contraction & Convergence' as elaborated by Meyer (2000). The fact that it would fall equally on all countries would also be a defence against it triggering a flight of carbon-intensive industries from developed to developing countries.

²⁰One tonne of carbon is equivalent to 3.67 tonnes of carbon dioxide. Global emissions of CO₂ were 25 billion metric tons in 2003, according to the EIA (2006), and without check, will be expected to rise to 33.7 billion metric tons by 2015 and 43.7 billion metric tonnes by 2030. See: <http://www.eia.doe.gov/oiaf/ieo/emissions.html>.

²¹Senator Hillary Clinton proposed a windfall profits tax on US oil companies, in a campaign speech delivered to the national Press Club in April 2006. The tax revenues would create a Strategic Energy Fund of perhaps \$50 billion. Companies would be relieved of the tax if they could demonstrate that they had made comparable investments in renewable energy options. See the speech at: <http://clinton.senate.gov/news/state-ments/details.cfm?id=255982>.

¹⁶A post-Kyoto tax regime of this kind has been discussed by authors such as Cooper (2004) and Kahn and Franceschi (2006) who outline many of the advantages of a tax regime, as well as by Pizer (2002) who discusses a combined emissions trading scheme and carbon tax; and Zhang and Baranzini (2004). Cramton and Kerr (2002) similarly propose a post-Kyoto tradeable permit scheme where permits are auctioned rather than 'grandfathered'. The disadvantage of an auction is that it generates revenues for the government rather than bringing carbon emitters onside as supporters of the scheme. Carbon emitters end up having to pay for the long-term permits as well as the short-term permits needed, which is not a way of enrolling their support.

¹⁷Such major transfers due solely to countries' having declined economically since the Kyoto base year of 1990, is one of the principal design defects of the Kyoto Protocol; see Nordhaus and Boyer (1999), Nordhaus (2001a) and Cooper (2004) for further discussion.

towards achieving GHG emissions reduction were seen as too slow, the authority could call an emergency meeting of nations to raise the level of the tax, and the level of funds to be returned to the agency for promotion of fossil fuel alternatives.²² Note that the scheme is a two-part system, where one part involves a carbon ‘trigger’ price applying to STPs, but the LTPs will trade at a price determined by the market.

A further effective initiative would be to allow the new carbon pricing authority to issue bonds in its own name, and offer them on the world’s leading bond markets in New York, London and Tokyo.²³ These could be called Global Greenhouse Bonds, and would be investment-grade vehicles based on the reliability and solidity of the global authority issuing them. The revenues from sales of these bonds, which could be expected to reach \$10 billion within a few years, could then be utilized to promote renewable energies, and to reward countries that take positive steps such as abandoning proposals for building coal-fired power stations. The World Bank and IMF already issue such bonds; a global GHG authority could certainly draw from their experience.

2.2. Step two: global satellite monitoring of GHG emissions

The second and complementary step is to monitor the production of GHG emissions to ensure that countries are operating the hybrid carbon permit and tax system honestly and effectively. Rather than expecting each country that signs on to the treaty to monitor carbon emissions from its own industries by satellite, it would make sense to perform this task globally, on behalf of all countries. (This is not to say that individual countries cannot monitor GHG emissions if they wish, and many would no doubt want to do so, such as the United States.) The data acquired by such satellite surveillance would be fed to an independent global authority to publicize the data and pass the identities of recalcitrants to the UN, the WTO, and the World Bank so that they can be publicly identified.²⁴ This is a function that is best suited to the carbon pricing authority itself, so that there would be a clear and present link established between levels of GHG

emissions around the world and the price imposed on carbon. Such an arrangement would also mean that the revenues raised by the carbon pricing authority could be expended partly on maintaining the satellite surveillance system.

2.3. Step three: compensating developing countries for preserving rainforest

Tropical developing countries preserve for the earth as a whole a vast public resource in the form of conserved rainforest which acts as a powerful carbon sink. According to the UNFCCC, if this rainforest is cleared (which is happening now at a rate of 1–2 percent per year) then it releases carbon emissions (from loss of carbon sink as well as release of carbon through burning) amounting to 25 percent of total planetary carbon emissions. Yet there are currently no mechanisms in place to offer tropical developing countries any incentive for preserving these important carbon sinks.²⁵ The Kyoto Protocol excludes deforestation issues, even from the Clean Development Mechanism, whereas reforestation after clearing is rewarded in the form of carbon credits. The perversity of such a situation scarcely needs underlining — as discussed by Stern (2006). While some proposals from developed countries have canvassed the possibility of exchanging debt relief for forest conservation, two serious proposals have emerged from tropical developing countries themselves. One from Brazil involves the allocation of offsets against Kyoto Protocol targets (Santilli et al. 2005) while a more ambitious proposal has been advanced by the Coalition for Rainforest Nations (led by New Guinea and Costa Rica) that envisages carbon credits being allocated to such countries exchangeable in international carbon markets. This latter proposal, by applying to the country as a whole, gets around the feared ‘loophole’ that would see compensated projects simply being substituted by new projects in the same country. Such carbon credits could generate financial flows that would offer serious compensation to countries for denying themselves the short-term benefits flowing from forest clearing, and provide them with the international backing needed to stop illegal deforestation — a policy proposal supported by Stiglitz (2007) amongst others. This proposal of the Rainforest Coalition is advocated in this paper as a third necessary step to curb greenhouse gas emissions.

2.4. Step four: creation of a global market for responsible biofuels

The fourth step is to actively promote the responsible development of biofuels as a global alternative to, and supplement to, fossil fuels. Scientific opinion is now

²²In this sense, the proposed GHG global carbon pricing authority would supersede the debate over a mooted World Environment Organization (WEO); it would exercise similar powers with vastly greater effectiveness. See Whalley and Zissimos (2002) for a well-argued case in favour of a WEO (based on internalization of climate change externalities) and Newell (2002) for a well-argued case against.

²³Adamson and Sagar (2002) mention such bond issues in the context of a discussion of the need for risk-reducing instruments needed to bridge the gap between groups entertaining very different views as to the likelihood of climate change.

²⁴See discussions of the use of satellite remote-sensing technology to collect data needed for verification purposes by such international treaties as the Kyoto Protocol, by Arbor (1999) or Rosenqvist et al (2003)—although the latter authors are more concerned with monitoring vegetation cover on the Earth than with point emissions of greenhouse gases.

²⁵Key tropical rainforests are those in Amazonia, in East Africa and in Southeast Asia, as discussed by Fearnside (2001); Glenday (2006) and KimPhat et al. (2004), respectively.

reaching a consensus that biofuels could account for 10% of all fuels by 2010, and for 20% by 2020, rising to 50% of a (reduced) consumption of transport fuels by 2050.²⁶ What can be done globally to further initiatives already underway in tropical countries producing ethanol from sugarcane and biodiesel from a variety of vegetable sources such as castor oil, *Jatropha*, palm oil and soybean? The third proposed step, to compensate tropical developing countries for preserving rainforest resources, is the necessary precursor to allowing biofuels to emerge as sustainable and responsible alternative to petrofuels.

On the positive aspect, what is needed globally is not so much a set of initiatives on the supply side (such as programs to establish new plantations, and to green the deserts with *Jatropha*) which can be safely left to individual countries and the private sector, but on the demand side, to grow the market for biofuels. It is clear that the developed world is establishing new chokepoints in the form of trade barriers to biofuels; these short-sighted initiatives need to be rolled back by a global commitment to creating a global free market in biofuels (as a first step to creating a global free market for energy).²⁷

A global agency is needed to drive this reform of the world trade system. Why not the WTO, which can thereby show that it is not just a club for the wealthy, but can actually take an initiative when needed in the name of all humanity?²⁸ Or if the WTO shrinks from the task, why not entrust this initiative to another global agency, UNCTAD, established a half-century ago to achieve trade justice for the developing world. The reduction of trade barriers for biofuels in the 21st century could be just the issue that would revive UNCTAD and make it a central player in trade issues again.

On the negative aspect, what is needed is a global agency—perhaps one of the UN agencies such as UNEP or a new global agency that will monitor and publicize deforestation and ‘blacklist’ any biofuels produced from such deforestation practices. Perhaps it would be most straightforward for the leading developing countries (led by Brazil, India and China) to create a Global Biofuels Trading Company which will intervene in markets to buy and sell biofuels, helping to create the global market

aspired to.²⁹ This GBTC would be able to act as guarantor of the provenance of the biofuels it trades in, stamping them with a quality mark of guarantee that they do not come from recent deforestation. It will refuse to deal in biofuels that cannot provide adequate documentation on their ‘safe’ provenance, and will publicize the reasons for such a refusal.³⁰ It might also be feasible for the developed countries of the North, driven by concerns over energy security (peaking of oil supplies) and global warming, to enter into a ‘Biopact’ with the tropical countries of the South to open up the markets of the North to biofuels produced responsibly and sustainably. Such a Biopact would constitute a multilateral trade agreement that could then be ratified by the WTO to give it a global seal of approval.³¹

2.5. Step five: creation and furtherance of markets for renewable electricity

The fifth step is to drastically step up the production of electric power from renewable sources—principally solar, wind energy, and biofuels (e.g. in combined heat and power systems). Again what is needed is not so much initiatives on the supply side (which can be left to individual countries and private companies) but on the demand side, to grow the market for renewable electric energy. We know how this can be done. The experience of several countries, including Denmark, Germany and some developing countries like Mauritius teaches that renewable electricity is expanded when existing electric power distributors are required to accept input from IPPs utilizing any of a range of renewable sources, with feed-in tariffs administered by an independent authority.³² We know also that the setting of mandatory targets for renewable (or ‘green’) power and the issuing of certificates by a national authority implementing such a scheme, also works.³³ The combination of the two micro-approaches working together would have

²⁶For a recent review of 17 such studies, see Berndes et al. (2003)—although the actual figures vary across the studies. Each region can certainly pursue biofuels adapted to conditions found there, such as rapeseed for biodiesel in Europe (Ryan et al., 2006), but it is unrealistic to see temperate regions becoming self-sufficient in biofuels. Far more expedient to open up the world market and to encourage trade in biofuels, both to accelerate the utilization of biofuels as a defence against global warming, and to encourage industrial development of tropical countries as the world’s suppliers of biofuels, thereby helping to solve both the climate change problem and the industrial under-development problem.

²⁷See Joseph Stiglitz, ‘Reasons for the demise of the Doha development round’, *Taipei Times*, August 15, 2006; available at: <http://biopact.com/2006/08/stiglitz-explains-reasons-behind.html>.

²⁸Zhang and Assunção (2004) discuss how WTO policies intersect with climate change considerations.

²⁹Each of these countries already possesses a national oil company that is moving to become a biofuels company. Brazil leads the way, with Petrobras, which now plays a leading role in the country’s ethanol and biodiesel trade, and is taking initiatives to market Brazilian ethanol abroad, e.g. in Japan. China has the China National Overseas Oil Corporation, which is signing ethanol deals, and the Indian Oil Corporation Ltd is also engaging in ethanol transactions. (See ‘Indian Oil map for biodiesel to be ready soon’, at: <http://www.iocl.com/displayit.asp?pathit=/media/med1543.txt>) It would not be insuperable to allow these three companies to form the proposed Global Biofuels Trading Corporation in the first instance, under international supervision.

³⁰In September 2006 Brazil proposed establishment of an international fund from which developing countries could draw if they could demonstrate slowing of deforestation. See: <http://www.planetark.org/dailynewsstory.cfm?newsid=37904&newsdate=01-Sep-2006>.

³¹Such a Biopact is discussed and elaborated in Mathews (2007a).

³²See Haas et al. (2004) for a clear review of the many instruments utilized to advance renewable energy sources, and wind energy in particular, and a clear conclusion that stepped feed-in tariffs emerge as the superior option.

³³See Kent and Mercer (2006) for a scholarly evaluation of the working of the Mandatory Renewable Energy Target scheme in Australia.

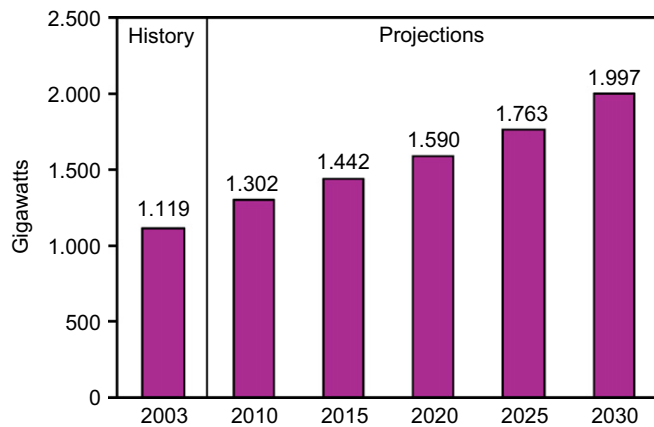


Chart 1. World Installed Coal-Fired Generating Capacity, 2003–2030. Source: Energy Information Administration. 2006. International Energy Outlook 2006, Chapter 6 Electricity. Washington, DC: EIA. (Website: <http://www.eia.doe.gov/oiaf/ieo/index.html>).

a powerful impact on the demand side, which is where it is needed.

The kind of electricity networks resulting from such a transition would be very different from the over-centralized systems built over the past century, and would instead foster the development of thousands and millions of small-scale producers all aggregating their excess output in a well-integrated and robust power system.³⁴ There is no doubt that renewable sources such as solar, wind and biomass can easily meet power demands: renewables already account for at least a quarter of installed capacity in California, a third of Sweden's energy, half of Norway's and three-quarters of Iceland's.³⁵

Again a global agency is needed to drive this process. Why not the World Bank, stepping up to make loans available all around the world to encourage IPPs to form and to be able to sell power to their national grid (or produce electricity independently of the grid in, say, remote village locations), and to finance the setting up of mandatory targets schemes? This would 'energize' the Bank and give it a fresh mandate. As designated global agency on this issue, the Bank would be required to produce an annual report detailing the extent of uptake of renewable energy promotion programs and the barriers to their further success.

2.6. Step six: a global moratorium on building new coal-fired power stations

An initiative is needed at a global level to tackle directly the biggest threat of all—an initiative that will send a

powerful signal that the international community is prepared to take strong and decisive action to deal with global warming that affects all. While the global carbon pricing system can be expected to deal effectively with future investment decisions regarding carbon, the backlog of issues to do with installed coal-fired capacity calls for special measures. Just as the world has been able to implement a moratorium on whaling (with patchy success) so it should be possible, given the urgency of the situation, to implement a moratorium on the greatest threat to the global climate, and the greatest source of GHG emissions—namely coal-fired power stations. This would have to be a global moratorium that bites. In effect, a moratorium would impose an infinite carbon tax on a specified sector which poses an immediate and present danger to the planet.

Global installed capacity in coal-fired power stations in 2003 amounted to just over 1000 GW (dwarfing investments in wind or solar) and is projected to expand, without policy change, to just under 2000 GW by 2030, according to the US Energy Information Administration (see Chart 1).

More to the point, capacity additions from new power plants based on coal are expected to rise from 0.5 GW in 2005 to over 8 GW in 2009.³⁶ Coal will continue to be the largest source of the world's electricity generation, in the absence of policy change, accounting for 40% of electric power output overall, and in China and the United States, the two countries with the highest reliance on coal, for 72% and 57%, respectively. As a result, it is projected that coal would account for 35% of the 43.7 billion metric tonnes of carbon dioxide emissions by 2030, in the absence of policy interventions. This is the grim situation that would be delivered by a 'business as usual' approach.

All it needs to start a global moratorium is a public stand by a country that states that it will regard investment in coal-fired power stations in its jurisdiction as hostile to its national, and the collective interest. Other countries could join in, particularly if the moratorium is backed by private sector funding contributions to compensate entities affected, as they make public their change in investment intentions. One of the UN agencies—such as UNEP—could take a lead as organizer of the moratorium, in the sense that it would publish relevant data on where the coal-fired power stations were located, and where it was proposed to build further such stations, or extend the life of existing stations. The agency could also publicize the existence of alternatives, and their costs. The global GHG emitter surveillance system would be able to pinpoint just where the emissions are coming from, if they have already been built. But the bite would really come from curbing the plans to build new such power stations. It would of course be unfair to China and India, with their vast coal reserves, and their hunger for energy. But there is enough scope for

³⁴This scenario is known as micro-generation; see Watson (2004) for a description.

³⁵For an overview, see Ian Lowe, address to the Australian national press club, Canberra, Oct 19 2005; see: http://www.acfonline.org.au/news.asp?news_id=582.

³⁶See "Planned nameplate capacity additions from new generators, by energy source, 2005–2009" in EIA (2006).

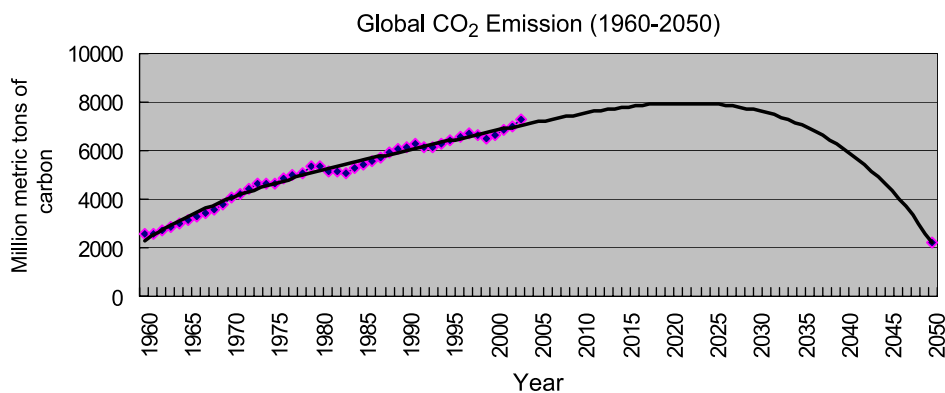


Chart 2. Global CO₂ trendline, 2010 to 2050, if Seven Steps implemented. *Source:* Author.

both China and India to build their power and fuel systems of the future from renewables, and sufficient reward for doing so, without the necessity of resorting to coal-fired systems emitting large quantities of carbon.

The moratorium could be backed eventually by the imposition of a fine, imposed by a global agency (e.g. the UNEP) which could go into a pool to serve as a fund for the promotion of power stations that utilize renewable energies, particularly in Brazil, India and China. This leads to the final step, which closes the loop and brings the actions of the developing countries, excluded from the Kyoto process, to the center of the world energy stage.

2.7. Step seven: creation of global incentives for developing countries that are moving to adopt non fossil-fuel industrial pathways

A final step would create a feedback loop between the global carbon pricing system and the gradual introduction of the developing countries into the world climate change control system. It would be concerned with acknowledging and enhancing the important initiatives already taken by the developing world—led by Brazil, India and China—in moving their economies away from fossil fuel dependence, and onto a renewable energies trajectory, and give these initiatives a boost. These countries are typically seen as potentially vast polluters whereas the reality is that they are likely to be the sources of permanent solutions to the world's GHG emissions problem. They are already taking important steps. India is moving rapidly to build its solar cells, wind energy and biofuels industries, while China is doing likewise and Brazil has already emerged as a world leader in biofuels.³⁷

The decisions to be taken by the developing countries in relation to their energy systems over the course of the next decade will actually be of profound significance to the success or failure of a program to deal with global

warming. In a highly competitive world, the developing countries need to be able to build energy systems that are not simply 'carbon copies' of those that have preceded them in the developed world. The issue is: can they escape the 'carbon lock-in' that has encompassed the developed world, and from which it is proving so difficult to break out?³⁸ Here they have considerable latecomer advantages available, as in their capacity to develop new biofuel-based transportation systems that by-pass the vast fossil fuel-based systems of the developed world, utilizing low-cost competitive advantages in the form of lower labor costs and advantages that build on their soil, sun and water resources as tropical countries. Indeed, the tropical developing countries have the opportunity to turn renewable energy sources from a marginal issue to a central focus of their development efforts, building industries around biofuels as well as renewable energy sources such as wind and photovoltaic cells—as Brazil, India and China are doing.³⁹

But these countries need to be given encouragement at a global level, to provide support for the political forces within these countries favoring renewable energies, and to deflect support from those favoring fossil fuels. A global stimulus could be played by the proposed ICPA which could recycle revenues raised by issuing bonds in its name, in allocating rewards to developing countries for every coal-fired power station cancelled and a renewable energy power producing system substituted for it. It would certainly be a surprise if one of the effects of global warming mitigation efforts turned out to be that developing countries secured a new developmental momentum based on renewable energy sources, and actually took the lead in the establishment of non-fossil fuel based energy trajectories, breaking free of 'carbon lock-in' in advance of the developed world.

³⁷See the WorldWatch Institute *State of the World 2006* report, with its special focus on India and China, and on biofuels in particular. On Brazil's alcohol program, see [Moreira and Goldemberg \(1999\)](#).

³⁸These are the terms used by [Unruh and Carrillo-Hermosilla \(2006\)](#), in a stimulating contribution to the literature.

³⁹The role of renewable energies in developing countries' industrialization strategies is discussed in [Mathews \(2007b\)](#).

This final step thus utilizes the financial resources raised by the global imposition of a carbon pricing regime and by the issuing of bonds and recycles these to provide clear incentives to developing countries to invest in low-carbon emission technologies and economic processes. In this sense the global warming control circle is closed.

3. The seven steps form a package

Here then is a package of seven steps that could be undertaken at the global level, between now and the year 2010, which could between them initiate changes at a global level that would start to reduce GHG emissions by 2020, and then lead them to a steady decline that would see the world safely embarked on a new energy trajectory by the year 2050—a trajectory that would not threaten the planet (see Chart 2). The changes already unleashed by 2007 will have their unavoidable effects in the future—the hurricanes, the rising sea levels, the loss of glaciers and snow-capped mountains, the disturbances to agriculture. But with drastic action of the kind described at a global level, these changes may not necessarily lead to catastrophic collapse of the Earth's global climate control system. The leading US climate researcher, Dr. James Hansen, stated at a conference in Sacramento, California in September 2006 that the world has a window of at most ten years to do something decisive about climate change; a 'business as usual' approach would mean that 'we are producing a different planet' and one that is hostile to life.⁴⁰ The Six Steps are formulated to provide the action plan that Hansen and many other scientists are calling for.

The seven steps build on each other in several repetitions as the world finally breaks free of its 'carbon lock-in' and generates a new energy trajectory for the planet. The system is designed as a self-reinforcing and self-sustaining process that gradually builds a global constituency for change in the direction of a low-carbon economy, utilizing minimal institutional initiative and coercion to do so. The seven steps complement the "seven wedges" discussed by Pacala and Socolow (2004), and indeed constitute the social and economic preconditions for the workability of the seven wedges, which are based on technological considerations only.

The seven steps are formulated to be feasible, practicable and to be self-financing. The imposition of the hybrid carbon pricing system will generate the revenues needed to drive the world away from its present carbon-intensive trajectory, without the need for further financial inputs. But such inputs will of course be coming forward in any case. Late in 2006, the British entrepreneur Richard Branson committed to putting \$3 billion of future profits from his transport companies into the development of new low-carbon fuels. Such initiatives are likely to be common as the serious consequences of global warming come to be

widely registered. It would be a welcome initiative if Branson or some other entrepreneur created a global prize for energy efficiency, which could be awarded to technologists and designers for the best energy-efficient products, houses and vehicles each year. Such prizes could come to assume the same stature as the Nobel prizes.

But the seven steps are not dependent on such external financing. Nor are they dependent on technological innovation; all the technologies needed to curb global warming exist.⁴¹ Thus the seven steps do not call on untried technologies such as carbon sequestration, or on technologies with unacceptable long-term consequences such as nuclear energy, nor do they depend on untried initiatives such as building solar power generators in space.⁴² It is a matter of overcoming the barriers to the diffusion and uptake of renewable energy technologies, rather than waiting for new technologies to be developed. And equity is built into the system in the sense that the carbon price falls on all, subject to ability to pay, while revenues are recycled to give greater priorities to efforts by developing countries to shift away from a carbon trajectory.⁴³

The steps also have the advantage that they are designed to mesh with a growing appreciation that technologies need to cut 'with' natural and planetary processes and not against them, if our business civilization is to have much future. Thus while fossil fuels encourage an arrogant attitude to nature, seeing the earth as simply something to be exploited, solar energy and wind energy by contrast give us a sense of living within our planetary, or Gaian, limits. Biofuels can themselves have the effect of greening the Earth (particularly by rolling back the deserts) if they are produced responsibly. These shifts have the potential to bring about far-reaching changes in humanity's attitudes to the tools it uses and the purposes to which they are put.

4. How to get there?

The seven steps will not grow out of current Kyoto 'top-down' mechanisms, nor will they emanate in time from bottom-up initiatives. The urgency of the climate situation calls for a fresh start at a global level. Where would such an initiative come from? Absent the political will to call the governments of the world together for yet another declaration of intent regarding the global atmosphere and climate (words in place of action) what is called for is a practical and realistic series of steps. One likely scenario is that the US and China, as the two leading GHG emitters and the two who are absent from the Kyoto process, will get together and hammer out a carbon pricing

⁴¹The seven steps thus follow the same strategy as Socolow et al. (2004) and Pacala and Socolow (2004) in posing existing technologies as sufficient to curb CO₂ emissions—except that Socolow et al. also include carbon sequestration and nuclear power.

⁴²See Hoffert et al. (2002), at p. 981.

⁴³There is of course a vast literature discussing the equity of climate stabilization; for a discussion from the perspective of energy system, see Wagner and Sathaye (2006).

⁴⁰The speech was widely reported; see: <http://www.commondreams.org/headlines06/0914-01.htm>.

system that is acceptable to both. They will then announce their joint commitment to such a hybrid scheme, and invite other countries to join them in an international action program. When enough countries have indicated their preparedness to do so, then an international conference could be convened, with the specific intention of creating a new global agency with responsibility for promulgating the details of a global carbon pricing system that would fall on all countries, together with an initial agreement on the level of the carbon price, and its anticipated increasing levels of incidence. Such an approach would presumably satisfy the US Congress as not threatening excessive interference in domestic affairs, and would satisfy the Byrd-Hagel resolution of the US Senate.

Such an international conference would not get bogged down in horse-trading over national quantitative targets for emissions reductions, because it would be concerned with formulating the details of a carbon pricing system that could be expected to rapidly come to occupy the central position in many countries' fiscal portfolios. The implementation of such a scheme by national governments would actually strengthen most countries' fiscal machinery, and would not be marginalized as are most environmental standards.

Would there be resistance to such a scheme? Of course there would be. But there would also be some surprising support. Business leaders in the US are practically begging for a carbon price to be imposed, as a 'final solution' to the global warming problem. The hybrid scheme, as discussed for example in the McKibbin–Wilcoxon Blueprint, is designed specifically to blunt entrenched opposition to a carbon price by giving stakeholders a part of the initial allocation of LTPs. But even so it would be hard for the US government on its own, or the Chinese government on its own, to impose such a strong measure involving a fresh allocation of property rights without the backing of the international community. That is why an initiative from the US and China jointly, who would then be joined by other nations, presents itself as a realistic and practical way forward.⁴⁴

The great advantage of such a proposal is that it would present itself as a measure needed to curb a very present threat, and as the only measure that is likely to really work.

⁴⁴There is increasing pressure on the Bush Administration to take a major initiative on global climate change, as captured in recent articles such as Bell (2006) in *Foreign Affairs* and by Saunders and Turekian (2006) in *The National Interest*. Bell's piece makes the familiar arguments regarding the deficiencies of Kyoto, but pulls back from offering suggestions for any dramatic initiative on the part of the US; she proposes micro steps that might work in the longer term, but misses the essential urgency of the global warming issue. The globally mandated carbon tax proposal is designed to meet the demands of urgency. Saunders and Turekian argue that Kyoto is a flawed process, and that the Bush Administration has done quite a lot outside of its confines, but could do a lot more—although their suggestion to take as a model the Asia-Pacific Partnership on Clean Development and Climate, created by the US and Australia as an alternative forum to Kyoto, and lacking any mandatory targets at all, cannot be taken seriously.

Kyoto has its faults, but no one would pretend that it can actually bring carbon dioxide emissions down by 70% by 2050—or anywhere near such a goal. The internationally mandated carbon pricing system could not be construed as an ideological measure, by either the Right or the Left, but rather as a practical measure designed to Save the Earth. So it would be seen as (1) mandated; (2) practical; and (3) the only available option. What better way for the Bush presidency to bow out in 2008 than with a surprise 'Beijing initiative' in the fashion of 'Nixon goes to China'? The process would gather momentum from there.⁴⁵

The internationally mandated carbon pricing regime would complement and go beyond any existing 'cap and trade' scheme, such as the European Emissions Trading System which has been implemented since January 2005 in the name of the Kyoto Protocol, as well as national schemes such as that introduced in Japan or even a cap and trade scheme that might be introduced on a mandatory footing in the US. The hybrid carbon tax and carbon permits system (the McKibbin–Wilcoxon Blueprint) would be a clear and unambiguous fiscal measure, without setting explicit caps on emissions. The cap and trade system, where it exists, would set such limits, and a timetable for reaching them, and offer carbon credits to firms as a means of assisting them to meet such targets. The two approaches should be seen as complementary rather than contradictory.

Finally it is worth pointing out that the seven steps are formulated in the full knowledge that overall, energy consumption needs to be reduced, and energy efficiencies need to be drastically improved. But there does not seem to be a safe or useful global mechanism for bringing these desirable features about—apart perhaps from an annual prize to be awarded to energy efficiency innovations. They are best left to national, state and local initiatives—where it is clear already that governments and agencies at these levels are only too willing and capable of taking the steps needed.

5. A global solution for a global problem

What the seven steps call for is global thinking around the issue of the institutional innovations needed to really get serious about global warming 'mitigation' (to use the phrase adopted by the IPCC). The steps involve the participation of global agencies, some already existing like the WTO, World Bank, IMF and UNEP, and some to be created such as a global carbon pricing authority and a global GHG emissions surveillance authority (which could be the same agency). A global problem demands global solutions and global initiatives.

⁴⁵This is not as far-fetched as it might seem. Such an initiative could grow directly out of the high-level Energy Policy Dialogue between the US and China, established in 2004 and reactivated in September 2006. See report 'United States, China seek to foster reliable, affordable energy' at: <http://usinfo.state.gov/xarchives/display.html?p=washfile-english-y=2006&m=September&x=20060920174929ajesrom0.4380609>.

Yet it must be emphasized that the seven steps are not designed to interfere with any initiatives being taken by countries or states through their own concerns and endeavors—such as those by California, Sweden and the Nordic countries and Brazil, and the many others that could be cited. If individual countries can accelerate their movement away from fossil fuels, then that is entirely to be applauded. The United States, for example, pioneered very effective emissions trading mechanisms to solve the acid rain problem, and is currently solving the methane problem (a greenhouse gas) with a similar scheme. It is entirely feasible that the US will come up with an effective national system for GHG emissions trading in the near future—and that it might even involve an international dimension, to give US firms credits for helping to clean up Chinese and Indian pollution sources, suggested by Easterbrook (2006) as an alternative to the Clean Development Mechanism of the Kyoto treaty in a recent Brookings Brief. In the UK, there are significant steps underway through the Stern Review on the Economics of Climate Change (Stern, 2006). The seven steps are designed to accommodate such existing and imminent national initiatives.

The seven steps are formulated in the full knowledge of the impending peaking of oil supplies, but are not predicated on any particular reading of when the ‘peak’ may be reached, or on any staged program of reductions in oil consumption as called for by, for example, the Rimini Protocol (the ‘Oil Depletion Protocol’). While the protocol is completely unworkable in an international environment, the net effect of the seven steps would be to bring about reductions in fossil fuel usage (and in particular reductions in GHG emissions from such usage) in accordance with the stated goals of the depletion protocol.⁴⁶

The ‘temperature’ of the Earth, as measured by the concentration of GHGs in our atmosphere, and the tons of carbon dioxide added each year, is about to become the most sensitive measure of the prospects of our survival, and that of life as we know it, on the planet. Globally, we have to do something drastic to measure it, to bring it down, and to enforce the provisions needed. The ‘temperature’ currently stands at 370 ppm, up from the pre-industrial level of 285 ppm, and these levels are now discovered to be higher than at any time in the past 650,000 years.⁴⁷ The seven steps are designed to provide a feasible solution to this most global and pressing of our problems.

Acknowledgments

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⁴⁶See Campbell (2006) for an exposition, and text of the Rimini protocol on the website of the Association for the Study of Peak Oil and Gas (ASPO), Ireland, available at: <http://www.peakoil.ie/protocol>.

⁴⁷See ‘CO₂ highest for 650,000 years’, BBC News report, available at: <http://news.bbc.co.uk/1/hi/sci/tech/4467420.stm>.

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