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# A True Comprehensive Approach

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# A TRUE COMPREHENSIVE APPROACH

Lakshman Guruswamy*

## I. INTRODUCTION

The need to preserve the global commons and protect the earth from global warming, echoed by Stewart and Wiener,[1] calls for immediate preventive measures that can expeditiously be implemented to control greenhouse gases. Unfortunately, the Stewart and Wiener version of the comprehensive approach, embraced by the United States in global warming treaty negotiations,[2] is a prescription for procrastination. This riposte will refer to the Stewart and Wiener approach as the United States Comprehensive Approach ("USCA"). The first part will outline why, despite its claims, USCA is significantly flawed. The second part will delineate the contours of a true comprehensive approach ("TCA").

To begin, global warming requires expeditious action, but, as Stewart and Wiener admit, USCA will take a long time to implement. While their paper offers no timetable or schedule, a reasonable reckoning is that it will take between one and two decades before the indices and the machinery for USCA are in place. This delay exposes a yawning chasm between strategies based on the need for urgent action, that this riposte endorses, and USCA which does not share this premise. Second, USCA ignores the realities of the current international order and the almost intractable difficulties of implementing USCA. Third, the kind of analysis, organizational infrastructure and level of sophistication demanded by USCA are simply absent within the domestic order of developing countries.

The need for a comprehensive or integrated response to global warming is undeniable. There can be little doubt that an integrated rather than fragmented strategy offers the most effective and efficient way of controlling greenhouse gases responsible for global warming. However, despite espousing the view that environmental policies should look beyond the effects to the sources of pollution, USCA is exclusively focused on the emissions of greenhouse gases alone. Emissions are no more than the effects arising from

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1. *See* Richard B. Stewart & Jonathan B. Wiener, *The Comprehensive Approach to Global Climate Policy: Issues of Design and Practicality* (elsewhere in this issue—Eds.).

2. In 1989, on the basis of IPCC studies the General Assembly requested that a framework convention on climate change be prepared. [General Assembly Resolution 44/207, 22 Dec.1989, para 10, 44 GAOR, Supp. No. 49 (A/44/49, at 130, 131)]. In 1990,3 the GA established an Intergovernmental Negotiating Committee to prepare the convention with the assistance of the United Nations Environment Program ("UNEP") and the World Meteorological Organization ("WMO"). [General Assembly Resolution 45/212, 21 Dec. 1990, para. 1].

other socioeconomic policies responsible for creating and supporting activities that result in emissions of greenhouse gases. By its very nature a genuine comprehensive approach must be given to exploring these sources. Alas, USCA refuses to do so. Rather, it militates against the fundamental integrative character of a TCA. This bundle of shortcomings exposes fundamental flaws in the practicability and the conceptual characterization of the comprehensive approach. This riposte will argue that emission limitations on carbon dioxide constitute the necessary initial steps in the development of a TCA that will seek to interdict our fossil fuel dependence.

## II. DEFECTS OF THE USCA

### *A. Delays and Difficulties of Implementing USCA.*

The Intergovernmental Panel on Climate Change ("IPCC") was established in 1988 by the World Meteorological Organization ("WMO") and United Nations Environment Program ("UNEP") to assess scientific information related to the various components of climatic change and formulate realistic response strategies.[3] IPCC measured the absorptive capacity of greenhouse gases by determining the extent of their radiative forcing ("RF"). When evaluating radiative forcing, IPCC found that over a 20 year horizon, methane,[4] nitrous oxides,[5] CFC-11,[6] CFC-12,[6] and HCFC-22[8] create a much greater warming effect in the atmosphere per kilogram than carbon dioxide. However, over a 100 year period this detrimental capacity was reduced[9] and even further diminished over a 500 year period.[10]

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3. Intergovernmental Panel on Climate Change, WMO/UNEP, Climate Change: The IPCC Scientific Assessment (J.T. Houghton, G.J. Jenkins and J.J. Ephraums eds., 1990) [hereinafter "IPCC Scientific Assessment"].

4. Methane produces approximately 63 times more RF than $CO_2$.

5. Nitrous Oxides produce approximately 270 times more RF than $CO_2$.

6. CFC-11 produces approximately 4500 times more RF than $CO_2$.

7. CFC-12 produces approximately 7100 times more RF than $CO_2$.

8. HCFC-22 produces approximately 4100 times more RF than $CO_2$.

9. Methane became 21 times; Nitrous Oxides, 290 times; CFC-11, 3500 times; CFC-12, 7300 times; and HCFC-22, 1500 times more RF than $CO_2$.

10. Methane became 9 times; Nitrous Oxides, 190 times; CFC-11, 1500 times; CFC-12, 4500 times; and HCFC-22, 510 times more RF than $CO_2$.

**TABLE 1**
***GLOBAL WARMING POTENTIALS***

The warming effect of an emission of 1 kg of each gas relative to that of $CO_2$. These figures are best estimates calculated on the basis of the present day atmospheric composition.

| GAS | TIME HORIZON 20 yr | 100 yr* | 500 yr |
|---|---|---|---|
| Carbon Dioxide | 1 | 1 | 1 |
| Methane | 63 | 11 | 9 |
| Nitrous oxide | 270 | 270 | 190 |
| CFC-11 | 4500 | 3400 | 1500 |
| CFC-12 | 7100 | 7100 | 4500 |
| HCFC-22 | 4100 | 1600 | 510 |
| HCFC-134a | — | 1200 | — |

Source: Intergovernmental Panel on Climate Change, WMO/UNEP, Climate Change: The IPCC Scientific Assessment xxi tbl. 3 (J.T. Houghton, G.J. Jenkins and J.J. Ephraums eds., 1990).

*Figures for the 100 year column and HCFC-134a are from Intergovernmental Panel on Climate Change, WMO/UNEP, 1992 IPCC Supplement 21 tbl. 3 (Feb. 1992).

Absorptive capacity, however, is only one of four critical factors that determine the global warming potential ("GWP") of a gas. The other three factors are its lifetime, volume, and synergistic quality in the atmosphere. When compared to the other trace gases, what emerges as significant is the much greater volume, and exceptional persistence of carbon dioxide. The IPCC figures based on 1990 anthropogenic emissions show that there were 26,000 teragrams of carbon dioxide emissions as against 300 of methane, 6 of nitrous oxide, 0.9 of CFCs, and 0.1 of HCFC-22. When IPCC calculated the volume *and* RF of all trace gases to ascertain their impact, the cumulative contribution of all trace gases over a 100 year period was found to be carbon dioxide, 61%; methane, 15%; nitrous oxide, 4%; CFCs, 11%; HCFC-22, 0.5%; and others, 8.5%.

TABLE 2
*THE RELATIVE CUMULATIVE CLIMATE EFFECT OF 1990 MAN-MADE EMISSIONS*

| GAS | GWP (100 yr horizon) | 1990 emissions (Tg) | Relative contribution Over 100 yr |
|---|---|---|---|
| Carbon Dioxide | 1 | 26000* | 61% |
| Methane** | 21 | 300 | 15% |
| Nitrous oxide | 290 | 6 | 4% |
| CFCs | Various | 0.9 | 11% |
| HCFC-22 | 1500 | 0.1 | 0.5% |
| Others | Various | — | 8.5% |

*26000 Tg (teragrams) of carbon dioxide = 7000 Tg (=7 Gt) of carbon
Source: Intergovernmental Panel on Climate Change, WMO/UNEP, Climate Change: The IPCC Scientific Assessment xxi tbl. 3 (J.T. Houghton, G.J. Jenkins and J.J. Ephraums eds., 1990).

** These values include the indirect effect of these emissions on other greenhouse gases via chemical reactions in the atmosphere. Such estimates are highly model dependent and should be considered preliminary and subject to change. The estimated effect of ozone is included under "Others". The gases included under "others" are given in the full report.

The greater importance of carbon dioxide is brought home by the most recent conclusions of the IPCC that the emission rates of methane and halogen compounds have slowed down, and furthermore, that global emission from rice paddies may amount to less than previously estimated.[11] Despite acknowledgement of these complexities, Stewart and Wiener argue that it is necessary to develop a GWP index for all greenhouse gases in order that USCA be applied. Such an index would attach differing weights to the various greenhouse gases on the basis of their absorptive capacity, volume, lifetime and synergistic attributes. They suggest no time frame but allude in their conclusion to the development of plans to deal with global warming in the next decade. Geologically, a decade may be a reasonable time to overcome the difficulties in drawing up an index. But in the face of the seriousness of global change, it is an excruciatingly long period to continue greenhouse emissions at present levels.

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11. Intergovernmental Panel on Climate Change, WMO/UNEP, 1992 IPCC Supplement, 7 (Feb. 1992) [hereinafter "1992 IPCC Supplement"].

In contrast to USCA, when the IPCC considered how to formulate appropriate response strategies, the Response Strategy Working Group was concerned that the longer emissions continue at present rates, the greater might be the reductions and costs in the future.[12] They concluded that "the potentially serious consequences of climate change on the global environment give sufficient reasons to begin by adopting response strategies that can be justified immediately even in the face of significant uncertainties."[13]

IPCC then identified measures to limit net greenhouse gas emissions and to increase the ability of society to adapt to the foreseeable consequences of significant future global warming. They eschewed policies that focused on only one group of emission sources and specifically called for a balance of abatement options among the energy, industry, forestry and agricultural sectors.[14] These measures included those that limit emissions from greenhouse gas sources (such as energy production and use); those that increase the use of natural sinks (such as forests and other biomass); and those that artificially enhance the capacity of natural sinks such as the oceans. Based on their expert analysis of an abundance of information, IPCC called for the following reductions to stabilize the atmospheric concentration of greenhouse gases at today's levels: carbon dioxide 60%, methane 15-20%, nitrous oxide 70-80%, CFC-11 70-75%, CFC-12 75-85%, HCFC-22 40-50%.[15]

In determining how to achieve their targets, cogent reasons led IPCC not to concentrate on the reduction of CFCs, nitrous oxides and methane. CFCs are already controlled by the Montreal Protocol which mandates an eventual ban on their production. Methane and nitrous oxides, on the other hand, are not controlled by existing international agreements, but the diffuse and disparate nature of their sources present significant difficulties in monitoring and control. Methane arises from rice cultivation, landfills, and natural gas leaks, while nitrous oxides are emitted from fertilizer use. Monitoring and control difficulties are compounded by the fact that the processes by which agricultural activities release both methane and nitrous oxide are not well understood.[16] Limiting GWP arising from methane and nitrous oxides also creates obstacles of an operational and decisional nature. The operational problems emerge when attempting to control methane from the numerous diffuse sources such as rice paddies, livestock systems, biomass burning, natural wetlands, termites, and landfills.[17] Additionally, we are faced with the difficulty that the extent of nitrous oxide emissions from terrestrial and

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12. Intergovernmental Panel on Climate Change, WMO/UNEP, Climate Change: The IPCC Response Strategies xxv (1990) [hereinafter "IPCC Response Strategies"].

13. *Id.* at xxvi.

14. *Id.* at xxxiv.

15. IPCC Scientific Assessment, *supra* note 3, at xviii.

16. *Id.* at 5.

17. Office of Technology Assessment, U.S. Congress, *Changing by Degrees: Steps to Reduce Greenhouse Gases* OTA-O-482, 246-49 (1991) [hereinafter "Changing by Degrees"].

aquatic sources and from fertilizer use is poorly understood.[18] The absence of monitoring mechanisms prevents these emissions from being identified with the accuracy possible in a power plant or refinery. There are hardly any monitoring networks for rice paddies, livestock, termites or bio-mass in existence. We need only recall the difficulties besetting the control of water pollution runoff from nonpoint sources such as fields and roads to understand the magnitude of the problem.[19]

Even if a satisfactory monitoring network were established, a decisional problem still exists for fixing emission standards that will ensure the cumulative GWP of these gases will not be exceeded. This is difficult enough when dealing with reasonably identified emissions such as carbon dioxide. It will be almost impossible to expect nations to set such standards for nitrous oxides and methane. The United States should be particularly appreciative of this dilemma given the obstacles encountered by individual states required to set up implementation plans dealing with the major ("criteria") pollutants under the Clean Air Act.[20] These drawbacks are compounded by the absence of monitoring networks for dealing with nitrous oxides or methane. Stewart and Wiener acknowledge these difficulties but suggest it is necessary to develop "emission indices" that could act as surrogates to facilitate measurement. Methane emissions from an acre of a given type of rice paddy or a cow given a certain type of feed would be measured by this method. These measurements then could be used to construct an index of emissions from a rice farm or a herd of cattle. In the next step, as Stewart and Wiener maintain, "one must inventory the amounts of different types of rice paddies or cattle and feed."[21] Finally, it would be necessary to inventory the totality of paddies and cattle in a given country.

It is unnecessary to dwell on the near impossibility of such an undertaking in developing countries ("LDCs") such as India or China. These countries are hard put to undertake an accurate census of people, yet are being called upon to embark on a census of cattle and an inventory of paddy under the plough! If the creation of a GWP index will take a decade, the kind of undertaking now being suggested by Stewart and Wiener could take up to half a century.

Furthermore, controlling the diffuse and disparate sources of methane and nitrous oxide emissions raise intractable problems within a primitive and

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18. *Id.* at 249-50.

19. *See, e.g.*, Conservation Found., State of the Environment: An Assessment at Mid-Decade, 105-28 (1984) [hereinafter "Assessment at Mid-Decade"].

20. Noel de Nevers, *Enforcing the Clean Air Act of 1970.* Many difficulties surround the roll back or diffusion models that enable officials to predict the amount by which specific sources will have to cut back on emissions to achieve a pre-determined ambient air quality. *See, e.g.*, Texas v. EPA 499 F.2d 289 (5th Cir. 1974); Cleveland Electric Illuminating Co. v. EPA, 572 F.2d 1150 (6th Cir.) *cert. denied*, 435 U.S. 996 (1978).

21. *See supra* note 1, at Part IV.C.

embryonic system of international law characterized by the absence of law-making, law-enforcing or law-interpreting bodies. There is broad agreement among legal philosophers, anthropologists and political scientists that a municipal or national legal system possesses agencies or entities that can change and create law and others that recognize, ascertain, define and implement legal rules through adjudication or administrative process.[22] The absence of these institutions in international society throw into sharp relief the inability of a developing international legal system to perform as if it were a mature domestic or national system of law. The difficulties adverted to above can only be solved by a more developed legal system.

### *B. Fragmented not Integrated*

Stewart and Wiener succinctly state that a policy response to global warming should be as broad as the sources of the problem. "By ignoring important sources of the problem, a piecemeal approach neglects important opportunities to solve it."[23] Unfortunately, USCA does just this. By rigorously restricting itself to the emissions of greenhouse gases and the reductions of such emissions alone, USCA confines its attention to symptoms of the problem. For example, in the case of carbon dioxide, the most important of the greenhouse gases, USCA excludes an examination of fossil fuel use that causes these emissions. USCA thus emerges as a fragmented not a comprehensive approach to global warming.

A comprehensive or integrated approach should be based on a synoptic or holistic design that embraces energy pollution in its totality. Any real comprehensive approach must encompass the whole web of pollution including its impacts, its socioeconomic sources and its implications.[24] A real

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22. *See, e.g.*, H.L.A. Hart, The Concept of Law 77 (1961); E.A. Hoebel, The Law of Primitive Man, ch. XI (1954); T. Parsons, *Law and Social Control in* Law and Sociology: Exploratory Essays (1962).

23. *See supra* note 1, at Part III.*A*.

24. Integrated Environmental Control ("IEC") is synonymous with a comprehensive approach. IEC and Integrated Pollution Control, the progenitor of IEC, is discussed in Lakshman D. Guruswamy, *Integrating Thoughtways: Re-Opening of the Environmental Mind*, 1989 Wis. L. Rev. 463 (1989); Lakshman D. Guruswamy, *Integrated Pollution Control: The Way Forward*, 7 Ariz. J. Int'l & Comp. L. 173 (1990); Lakshman D. Guruswamy, *The Case for Integrated Pollution Control*, 54 Law & Contemp. Probs. 41 (1991) [hereinafter "Case for Integrated Pollution Control"]; Lakshman D. Guruswamy, *Integrated Environmental Control: The Expanding Matrix*, 22 Envtl. L. 77; Conservation Found., Controlling Cross-Media Pollutants (1984); Conservation Found., New Perspectives on Pollution Control: Cross-Media Problems (1985); Assessment at Mid-Decade, *supra* note 19; Conservation Found., The Environmental Protection Act, Second Draft (1988)[hereinafter "Second Draft"]; Barry G. Rabe, Fragmentation and Integration in State Environmental Management (1986); Integrated Pollution Control in Europe and North America (Nigel Haigh & Frances Irwin eds., 1990). The National Research Council and National Academy of Public Administration have lent their weighty support towards the adoption of an integrated approach to pollution control. *See* Nat'l Res. Council, Multimedia Approaches to Pollution Control: A Symposium Proceedings (1987); Nat'l Acad. of Pub.

comprehensive approach starts with the principle that the impacts of all, not just one of the GHGs should be dealt with. But, unlike the misnamed United States version, a true comprehensive approach does not stop there. Instead, it pursues the GHGs to their sources within the web of energy policy and decisionmaking. Such an exploration may also uncover the links between fossil fuels and other greenhouse gases. For example, it has been found that a full 20% of anthropogenic methane emissions are of fossil fuel origin.[25]

Greenhouse gases could be analyzed as possessing both horizontal and vertical dimensions. The horizontal is comprised of all greenhouse gases, while the vertical encompasses their sources. A true comprehensive approach should explore the axis between the vertical and horizontal dimensions of greenhouse gases. Yet, the USCA categorically refuses to do so. In fact, it reproaches the pursuit of carbon dioxide emissions to their sources arising from fossil fuel based energy policies as "carbocentric" thinking.[26] The USCA, like Janus, exasperatingly faces both ways. It professes a comprehensive approach yet simultaneously rejects vital and fundamental principles of such an approach.

Furthermore, the United States' objections to binding time tables for reducing carbon dioxide apply equally to its proclaimed objective of reducing all greenhouse gases. This is because carbon dioxide reductions must be a component of any comprehensive package embodied in a treaty dealing with global warming. In negotiating such a treaty, the United States resolutely refuses to set time tables for such reductions. As a result the United States' professed objective of halting global warming becomes functionally unattainable and is rendered aspirational rather than obligatory.

## III. TRUE COMPREHENSIVE APPROACH

### *A. Outlined*

Climatic change admittedly is an unprecedented multi-media pollution problem that affects atmospheric, aquatic and terrestrial environments. Its complexity and magnitude, however, should not camouflage the fact that global warming is essentially a problem of pollution caused by energy generation, transportation and use. The phenomenon of global warming

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Admin., Steps Toward a Stable Future (1986). In the United Kingdom, the Royal Commission on Environmental Pollution ("RCEP") has taken the lead in advocating an integrated approach. *See* RCEP, Best Practicable Environmental Option, Rep. No. 12 (1988); RCEP, Managing Waste: The Duty of Care, Rep. No. 11 (1985); RCEP, Tackling Pollution-Experiences and Prospects, Rep. No. 10 (1984); RCEP, Air Pollution Control; An Integrated Approach, REP. No. 5 (1976). *See also* U.K. Dept. of the Env't: Integrated Pollution Control (1988).

25. 1992 IPCC Supplement, *supra* note 11, at 12-13.

26. Richard B. Stewart & Jonathan B. Wiener, *A Comprehensive Approach to Climate Change*, Am. Enter., Nov.-Dec. 1990, at 3.

should have removed the miasma obscuring the link between energy and pollution, illuminated the bared nexus between energy and the environment,[27] and shocked the United States into taking a fresh look at energy pollution.

Unfortunately the enormity of the problem has misled the United States into analyzing global warming as if it lay beyond the pale of pollution. This mistake has resulted in a search for solutions that largely ignores the principles governing pollution and has spawned descriptive and prescriptive errors. This article addresses these errors and argues that global warming should be treated as a problem of energy pollution within the analytic of a TCA, herein expounded. The fact that global warming is a particularly egregious and difficult case of pollution is not a compelling reason for exempting global warming from the analytic.

A TCA confronts the subject of energy pollution, traces its sources to the web of decisionmaking surrounding the energy sector, and argues that the most satisfactory method of dealing with energy pollution is based on an integration of energy and environmental policies. An examination of the sources of pollution, enmeshed within the milieu of socioeconomic decisionmaking, makes manifest the interlocking and inseparable worlds of socioeconomic and environmental decisionmaking.[28]

Applying the analytic of TCA to the sources of energy pollution undoubtedly has profound implications. To the extent that fossil fuels are the cause of energy pollution, the analysis will pose excruciatingly difficult questions about our continued reliance on cheap and abundant energy derived from fossil fuels. The importance of massive reservoirs of inexpensive, usable energy cannot be overestimated. The colossal array of activities required to satisfy the demands of modern society for creature comforts is fueled and powered by cheap and abundant energy. Indeed, it is almost a truism that the most important reason for the unprecedented prosperity and luxurious life style of the developed world is the availability of inexpensive and abundant energy,[29] primarily derived from the combustion of fossil fuels.

This riposte will very briefly summarize the case for a TCA before sketching how it should be applied. A true comprehensive approach begins by assessing the environmental impact of a given source and use of energy. This includes an evaluation of all socioeconomic impacts. Some of the impacts of fossil fuel pollution include environmental damage, energy insecurity, and resource depletion affecting future generations. TCA then proceeds to determine how adverse environmental impacts might be countered. A source by source evaluation of all relevant energy options is undertaken in order to arrive at the right answers.

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27. Lakshman D. Guruswamy, *Energy and Environmental Security: The Need for Action*, 3 J. Envtl. L. 209 (1991)[hereinafter "The Need for Action"].

28. *See* World Comm'n on Env't and Dev., Our Common Future 310 (1987).

29. Barbara Ward & René J. Dubos, Only One Earth 9-10 (1972).

The TCA analysis of this riposte endorses John P. Holdren's largely ignored guidelines for evaluating energy options.[30] First, the environmental impacts, pathways, stresses and responses of differing energy sources is analyzed. This is followed by a systematic and comprehensive comparison of the impacts produced by alternative energy options. Finally, the most beneficial energy paths are selected.

Every source of energy be they traditional sources such as coal, natural gas, oil, and nuclear power, or renewable sources such as solar, wind, hydro, geothermal, and biomass usually involve a sequence of some kind of environmental impacts from discovery to final application. Impacts attend exploration, harvesting, concentration, refining, conversion, transportation, storage, marketing, and end use through varying stages of research and development, commercial construction, operation and maintenance, dismantling, and management of wastes.

"Pathways" traverse air, water, and land. The polluting effects of energy development may enter one medium or pathway at the source but move across media boundaries and reach the receptor through more than one medium.[31] "Impacts" refer to how inputs that find their way through pathways affect humans and the environment. They include reduced resource availability, pollution of air, water, land and biota, harm to human health, damage to habitat and ecosystems, altered hydrology and changes to climate, and possibilities of social and political disruptions arising, for example, from conflicts over access to energy.[32]

We begin with environmental impacts in applying the above outline because they point to the need for a TCA. Vast resources are used by governments, agencies and industry to neutralize the adverse impacts of fossil fuels. When coal or oil are burned, pollutants in the form of carbon dioxide, sulphur dioxide, nitrogen oxides and a variety of particulates are released. The United States spends approximately $80 billion on pollution control today, and this is projected to rise to $160 billion by the year 2000.[33] A significant portion of these expenses can be attributed to the effects of fossil fuels. Fossil fuels create problems of acid rain, urban smog, sludge,[34] and hazardous chemical disposal,[35] manifested in air, water and land.

The continued emission of greenhouse gases at present rates would commit us to increased concentration for centuries ahead.[36] In these

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30. John P. Holdren, *Environmental Impacts of Alternative Energy Technologies for California*, *in* U.S. Dep't of Energy, Distributed Energy Systems in California's Future: Interim Report, Vol. II (HCP/P7405-03, May 1978).

31. Case for Integrated Pollution Control, *supra* note 24, at 42.

32. *Id.*

33. U.S. Gen. Acct. Off., Environmental Protection 17 (1991).

34. National Energy Strategy 144 (1st ed. 1991-92).

35. Council on Envtl. Quality, Toxic Substances (1971).

36. Changing by Degrees, *supra* note 17, at 46 tbl. 2.1.

circumstances it behooves us to consider the possible environmental costs of climatic change. The need to do so becomes all the more poignant in light of the fact that according to the IPCC, climatic changes may be even more serious than predicted.[37] Perhaps the most significant of the projected changes involves sea level rises. The cost of protecting coastlines in the United States alone will run into the billions of dollars.[38] This does not take account of the global loss of ecosystems, increased storm frequencies, or damage to the world's fish catch. Neither does it take account of the destruction of island nations and the low lying areas in LDCs.

In addition, the costs of adverse impacts on agriculture need to be brought into any equation evaluating the impact of energy pollution. Crop impact analyses show that warmer average temperatures of 1°C- 4°C are detrimental to both wheat and maize yields in the Great Plains and in Western Europe.[39] This is because higher temperatures adversely affect crop moisture and hence crop growth. With no change in precipitation an increase of 1°C might decrease yields by 5%, and at 2°C, yields may decrease 10%.[40] Average yields may be reduced from between 3% and 17%.[41] It is plain that global warming will adversely affect agriculture, particularly in the tropics and the developing world.[42] In the United States it is estimated that a 3.8°C to 6.3°C warming will be accompanied by a 10% reduction of soil moisture.[43] On the basis of these figures a comprehensive EPA study estimates there will be a decrease in yield of all major un-irrigated crops in the United States.[44]

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37. *Id.*

38. The costs of protecting shorelines from rising seas could range from $24,633 million to $80,176 million. The Potential Effects of Global Climate Change on the United States 344 (Joel B. Smith & Dennis A. Tirpak eds., 1990) (U.S. EPA report to Congress) [hereinafter "Potential Effects"].

39. Martin Parry, Climate Change and World Agriculture 49 (1990).

40. The estimated decrease of 5% is subject to +/- 4%, while the estimated reduction of 10% is subject to +/- 7%. Id.

41. *See* Essam El-Hinnawi & Manzur H. Hashmi, The State of the Environment 23 (1987) (citing UNEP/ICSU/WMO, *Report of the International Conference on the Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts*, WMO Doc. WMO-No. 661 (1986), *see also* The Impact of Climatic Variations on Agriculture (Martin L. Parry et al. eds., 1988); R.A. Warrick et al., *$CO_2$, Climate Change and Agriculture*, *in* The Greenhouse Effect: Climate Change and Ecosystems 425 (Bert Bolin et al. eds., 1986).

42. Parry, *supra* note 39, at 105-124.

43. According to the Goddard Institute for Space Studies, and Geophysical Fluid Dynamics Laboratory general circulation models. *See id.* at 80-83.

44. Potential Effects, *supra* note 38, at 367-417. However, the EPA study arrives at a questionable conclusion. According to the study there will be an increase of yield in the north arising from the fact that farming zones will shift 175 km northward for each °C in warming. The study then adds the crop increases from unfrozen fields to projected increases in irrigation amounting to as much as 25% in the southern states and 10% in northern states, to arrive at a re-assuring conclusion. Supplies of food will be sufficient to meet current and projected demand, though at slightly higher prices. The conclusion begs a number of questions. An important one amongst these is the assumption that more irrigation water will be available. This simply is incorrect.

The cost of energy security must be added to these impacts. The world still gets nearly half of its energy from oil, and this fuel accounts for well over 40% of United States energy use. All recent U.S administrations have viewed the strategic Persian Gulf region as an area of vital security interest.[45] The challenge to security arises from the extent to which the U.S economy depends on oil. First, disruptions to our oil supply could have traumatic economic implications. Second, United States foreign relations could be affected if allied solidarity becomes undermined by competition for scarce resources. Third, defense capabilities may be diminished if oil supply disruptions coincide with a major defense emergency. Without a doubt, the Gulf War has emphatically driven home our dependance on imported oil. It is no longer possible to exclude the price of energy security from the costs of fossil fuels. The price of energy security must include the costs of war, loss of life and the likelihood of a permanent military presence to ensure supplies of "cheap" oil.[46]

The present consumption patterns of fossil fuels will exhaust these non-renewable sources of energy and deny them to posterity. It is arguable, as Edmund Burke has contended, that "society is indeed a contract . . . a partnership not only between those who are living, but between those who are dead, and those who are to be born."[47] If so, we the present generations have intertemporal and intergenerational moral obligations which we dishonor by depriving future generations of a resource left to us by our ancestors. Having ascertained the costs and impact of fossil fuels, a true comprehensive approach calls for a consideration of alternatives. John P. Holdren's preliminary but highly significant attempt to apply an integrated approach to alternative energy paths was undertaken in 1978.[48] It was fleetingly noticed[49] but has been all but ignored. The evaluation was made at a time before the full magnitude of the dangers of global warming had become evident. The magnitude of global warming make Holdren's findings on the use of coal and oil even more forceful. Holdren did not purport to arrive at his findings on the basis of exhaustively verified empirical evidence. Indeed such conclusive evidence was lacking at the time he wrote, and he hoped that his preliminary analysis would lead to a more substantial verification of the thesis he offered. However, his preliminary examination was far more penetrating than a merely impressionistic exercise and was based on a

45. U.S. Dep't of Energy, Energy Security: A Report to the President of the United States 8 (DOE/S-0057, 1987).

46. *See* The Need for Action, *supra* note 27.

47. Edmund Burke, Reflections on the French Revolution and other Essays 94 (Ernst Rhys ed., 1910) (1790).

48. Holdren, *supra* note 30.

49. It was noted in the technical part of the Global 2000 Report. U.S. Council on Envtl. Quality and U.S. Dep't of State, The Global 2000 Report to the President 348-349 (1979).

coherent and rigorous analytic. Consequently, his conclusions possess a quality and timbre that render them of high probative value.

Holdren compared the impacts of a variety of traditional (hard) and non-traditional (soft) energy sources. The hard sources included coal, coal gasification, domestic gas, imported gas, imported and domestic oil, and nuclear power. The soft energy paths he considered were solar, wind, biomass, geothermal and end use efficiencies. The application of objective criteria led to an unequivocal conclusion. The environmental impacts of renewable sources such as solar and wind power were unquestionably less than the non renewable sources.

The alternative vision to the USCA accepts the need to cut carbon dioxide by 60-80%. Facing this daunting task in light of the reality that fossil fuels account for 75% of the world energy supplies calls for drastic measures that will reduce the use of fossil fuels by up 90% and produce goods and services with a third to half as much energy as today.[50] It argues that the key to doing so is energy efficiency.[51] Employing efficiencies in the way we use electricity, construct buildings and design cars could double or even quadruple[52] our available energy supplies.[53] Efficiencies will buy time during which it would be possible to switch to renewable sources of energy like wind, solar, photovoltaic geothermal and biomass.

### *B. Moving Forward*

The case for TCA can be argued from the recently established baseline created by the Pollution Prevention Act 1990 ("PPA") and the Administration's strong endorsement of risk assessment and risk management.[54] The PPA is a relatively unremarked piece of legislation that constitutes an important, even critical step in our legislative history and embodies significant features of TCA such as control at source and preventive environmental action. Admittedly, it is flawed by the narrowness of its vision and the lack of implementing strategies, but it does provide a baseline from which to approach the problems of energy pollution. Similarly, risk management sets priorities among the risks presented by pollution and chooses the appropriate

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50. Worldwatch Inst., State of the World 1991 25-26 (1991).

51. Hal Harvey & Bill Keepin, Energy: From Crisis to Solution 1 (1991).

52. *Id.* at 2; Amory B. Lovins, *Energy Strategy: The Road Not Taken?*, 55 Foreign Aff. 65, 72 (1976) [hereinafter "The Road Not Taken?"]; Amory B. Lovins, *End-Use/Least-Cost Investment Strategies*, *in* World Energy Conference, Energy For Tomorrow 329, 332 (1990) (Digest of the 14th World Energy Conference, Montreal 1989) [hereinafter "End-Use/Least-Cost"]; Worldwatch Inst., *supra* note 50, at 26 (1991).

53. The Road Not Taken?, *supra* note 52; EndUse/Least-Cost, *supra* note 52, at 329, 332.

54. *See* U.S. EPA, Unfinished Business: A Comparative Assessment of Environmental Problems (Volume 1 Overview) (1987) [hereinafter "EPA, Unfinished Business"]; U.S. EPA, Reducing Risk: Setting Priorities and Strategies for Environmental Protection (1990) [hereinafter "EPA, Reducing Risk"]; William K. Reilly, Taking Aim Toward 2000: Rethinking Our Nation's Environmental Agenda, 21 Envtl. L. 1359 (1991).

reduction action for the risks so selected. In doing so, risk management confluences with TCA.

Congress concluded that there are significant new opportunities for reducing or preventing the billions of dollars the United States spends on controlling pollution. It recognized that opportunities for source reduction are often not realized because existing regulations and the industrial resources they require for compliance focus upon treatment and disposal rather than source reduction. Accordingly, Congress embraced the need for cost effective changes in production, operation and raw material that would reduce or prevent pollution at source.

The PPA accepts the need for multi-media management.[55] Its finding is that "source reduction is fundamentally different and more desirable than waste management and pollution control" and that the "Environmental Protection Agency needs to address the historical lack of attention to source reduction."[56] The PPA further crystallizes some essentials of TCA by declaring that the national policy of the United States is that pollution should be prevented or reduced at source whenever feasible.[57] The Administrator of the EPA is charged with developing and implementing a strategy promoting "source reduction".[57]

The "ex ante" approach to pollution control embodied in PPA is a far cry from the "ex post" laws and policies to which we have become accustomed. While PPA is a significant step forward, it is unable to address the fundamental restructuring demanded by energy pollution.[59] Viable preventive technologies or processes for removing carbon dioxide from fossil fuels simply do not exist. The measures necessary to prevent or reduce fossil fuel pollution at its source require changes of the kind envisioned by TCA.

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55. 42 U.S.C.A. § 13101 (Supp. 1991).

56. 42 U.S.C.A. § 13101(a)(4) (Supp. 1991).

57. 42 U.S.C.A. § 13101(b) (Supp. 1991).

58. 42 U.S.C.A. § 13103(b) (Supp. 1991). Source reduction is defined as any practice which reduces the amount of any hazardous substance, pollutant or contaminant entering the waste stream. Source reduction includes equipment technology modifications, process or procedure modifications, reformulation or redesign of products, and substitution of raw materials. 42 U.S.C.A. § 13102(5)(A) (Supp. 1991).

59. It is wise to guard against false hope. Although PPA declares a shift in the focus of pollution control from effects to sources and resonates with prophetic cadences (§ 13101(b)), the portents for a hortatory bang fizzling into an implementing whimper are disappointingly high. All that is provided by way of institutional implementation is a charge to the already harassed and overburdened Administrator of EPA to develop and implement a strategy to promote source reduction (§ 13103(b)). Infirmities in its implementation are compounded by weaknesses in the vision and substantive obligations of PPA. Furthermore what PPA institutionalizes is the operational modality of TCA that concentrates on preventive technology and modifications of plant together with process and procedure redesigns. An operational version of TCA largely assumes the need for activities and products that lead to pollution but seeks to neutralize the deleterious effects of such activities and demands. Operational TCA does not provide for a truly comprehensive approach to pollution control that can radically and strategically change the sources and demands that lead to pollution.

Therefore, in order to deal with energy pollution we need to advance from the preliminary steps taken by PPC to the TCA advocated by this article.

Risk assessment offers both a framework and a quantitative measure for achieving some of the objectives of TCA. According to an influential report of the National Research Council[60] risk evaluation embraces two distinct and different exercises: risk assessment and risk management. Risk assessment uses objective scientific facts to define the health effects of exposure of individuals or of populations to hazardous material and situations.[61] Risk management is the process of weighing policy alternatives and arriving at policy decisions.[62] Both steps could be integrated into TCA. Risk assessment could be used to ascertain the environmental impact of fossil fuels and risk management to design comprehensive strategies to deal with such risks.

The need for risk assessment has been endorsed by a wide range of environmental policymakers[63] including a notable non-governmental environmental organization—the Conservation Foundation.[64] It has also found favor with EPA. The agency is attempting to apply the principles of risk assessment and risk management to the broad range of issues that it confronts.[65] Furthermore, NEPA and the mechanisms referred to in the Energy Strategy, such as Integrated Resource Planning could be harnessed to PPA and risk management to create a framework in which to implement TCA.

The two energy paths, differently described as "hard" and "soft"[66] or "renewable" and "non renewable" have been seen as mutually exclusive.[67]

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60. Nat'l Res. Council, Risk Assessment in the Federal Government: Managing the Process (1983).

61. Harry Otway, *The Perception of Technological Risk: A Psychological Perspective*, in Technological Risk 35-36 (Meinolf Dierkes et al. eds., 1980) cites this view in order to criticize it.

62. *Id.* at 3.

63. For example, most of the contributors to a recent symposium on risk assessment, Barry Commoner being a notable exception, uncritically accepted that risk assessment, like dietary fibre, is a good thing. *See* Symposium, *Risk Assessment in Environmental Law*, 14 Col. J. Envtl. L. 289 (1989).

64. Second Draft, *supra* note 24.

65. *See* Council for Envtl. Quality, Environmental Quality 211-46 (1984) (Fifteenth Annual Report setting forth the theoretical framework for conducting risk assessments and applying them to risk management decisions, as conceived and practiced by EPA). *See also* EPA, Unfinished Business, *supra* note 54, at 1-4; EPA, Reducing Risk, *supra* note 54.

The emphasis on such a methodology is borne out by the fact that EPA Guidelines for Carcinogen Risk Assessment provide that risk assessments must "use the most scientifically appropriate interpretation" and should be "carried out independently from considerations of the consequences of regulatory action." 51 Fed. Reg. 33,992, 33,992-93 (1986). Howard Latin perceptively observes that the EPA's present preoccupation with "good science" reflects a commitment to risk assessment grounded exclusively on the best available scientific theories even if the scientific theories lack the certainty required for valid scientific conclusions. Howard Latin, *Good Science, Bad Regulation, and Toxic Risk Assessment*, 5 Yale J. on Reg. 89, 89-90 (1988).

66. The Road Not Taken?, *supra* note 52, at 77.

67. *Id.* at 65.

Whether such is the case is moot. The way forward is not to begin with any ex-hypothesis paradigm but rather to apply TCA in order to determine the path or paths to be taken. When applied to the causes of global warming—found in the production, distribution and use of our energy—the evaluative process begins with an environmental impact analysis and proceeds to a comparison of possible alternatives, with a view to arriving at the best option. TCA does not postulate any *a priori* hypotheses whether based on "hard" or "soft" energy paths. What is envisioned is an objective evaluation of the environmental impacts of each option. It is perfectly possible that a "soft" energy option can result in environmental impacts as onerous as that of a "hard" one.

## IV. CONCLUSION

Global warming is a problem of energy pollution. Solving this problem requires a comprehensive or integrated approach that explores the whole axis between the horizontal and the vertical analysis of global warming. The Stewart and Wiener analytic stops at the horizonal: the taking into account of all emissions of greenhouse gases. Any genuine comprehensive approach must, as Stewart and Wiener admit, be "as broad as the sources of the problem."[68] It must, in other words, also take account of the vertical dimension of global warming. Unfortunately, USCA conspicuously fails to address the sources of greenhouse gases. It begins and ends with the horizontal principle that the impacts of all, not just one of the GHGs, should be dealt with.

Unlike the misnamed United States version, a real comprehensive approach does not stop with a count of all greenhouse gases. Instead, it pursues these GHGs to their sources since the primary sources of greenhouse gases are fossil fuels. Therefore, TCA begins by exploring our dependence on fossil fuels.

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68. Stewart & Wiener, *supra* note 1, at Part III.A.