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HOW TO CURB GLOBAL WARMING AFTER 'HOPENHAGEN' AND 'CLIMATE-GATE'

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Introduction

In November 2001, at the seventh 'Conference of the Parties' (to the United Nations Framework Convention on Climate Change) in Marrakech, the head of the diplomatic mission from one of the largest developing countries told me that it would be impossible to agree on a 'second commitment period'. That was UN-speak for predicting that a successor treaty to the Kyoto Protocol (which covers the 'first commitment period' up to 2012) would never see the light of day. Even back then, more than three years *before* the Kyoto Protocol entered into force in February 2005, it was clear to at least some of the diplomats involved in the global warming-negotiations that the financial and ideological differences between governments were too vast to ever allow the emergence of a meaningful, binding, global treaty. This was worrying given that the cutbacks of greenhouse gases foreseen in the Kyoto Protocol were generally perceived as well-nigh insignificant and 'just a first step'.

This past December, my interviewee's prediction was borne out by the dismal results of the fifteenth Conference of the Parties held in Copenhagen (which for the occasion was renamed 'Hopenhagen' by a number of environmental groups and companies).[1] Here, China and India expressly demanded far greater emission reductions and money transfers from developed countries than the United States was willing to accept while refusing to legally bind themselves to any cutbacks of their own emissions In the end, the weakest of agreements – the so-called Copenhagen Accord– was reached in exclusive negotiations between the United States, China, India, Brazil and South Africa, which was then 'taken note of' (*i.e.,* not adopted) by the entire Conference.[2] Surely, the acrimony and failure of the Copenhagen Conference spell the end of the nineteen years-long' search for a globally binding global warming-treaty.

Some weeks before 'Hopenhagen', a number of hacked emails sent between members of the Climate Research Unit of the University of East Anglia and other colleagues were published online. Dubbed 'climate-gate' by critics of

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[1] Listed on http://www.hopenhagen.org (28 December 2009).

[2] The content of the Copenhagen Accord can be found at: http://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf (28 December 2009).

the notion of human-made global warming, and 'email-gate' by their adversaries, these emails suggested that some of the most influential climatologists had not always adhered to the loftiest academic ideals in building their case for human-made global warming.[3] It appeared that they had embellished some of their results, sought to keep their academic opponents out of scientific journals (a prelude to complaining that their opponents did not have enough academic publications to be taken seriously), downplayed some contradictory evidence and destroyed historical data.

The online-posting of these emails was not an isolated incident. In the last few years, the critics of the thesis that human emissions of carbon dioxide and other gases will lead to dangerous global warming and climate change have become increasingly vocal. For instance, in 2007 one hundred scientists addressed an open letter to United Nations (U.N.) Secretary-General Ban-Ki Moon in which they stated that the science of climate change was far from settled, and argued against cutting human emissions of greenhouse gases.[4] A year later, a US Senate Minority Report listed over 650 scientists who had raised doubts about the reliability of parts, or the entirety, of the chain of reasoning that ends in the prediction of human-made climate change.[5] Among the many 'skeptical' arguments that have been advanced by scientists: global warming is not, or no longer, or hardly, occurring; atmospheric levels of carbon dioxide (supposedly the most ubiquitous greenhouse gas emitted by humans) follow, rather than lead, changes in global temperatures. The computer models used by the IPCC are inadequate to capture the complex interactions between so many different natural systems and phenomena, and are also non-falsifiable; these models only predict global warming as they incorporate unrealistic assumptions about the future economic growth of developing countries; to the extent that global warming is taking place, it could not possibly be human-made (but must instead be the result of natural cycles of solar radiation and/or oceanic currents, or of yet unknown factors). Any anthropogenic global warming would benefit, rather than harm, societies; and even if such warming had an overall negative impact in the long run, then it would still be better to adapt to climate change in due time, while focusing on more pressing economic and ecological problems now.[6]

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[3] Andrew C. Revkin, 'Hacked E-Mail Is New Fodder for Climate Dispute', New York Times (20 November 2009); David Fahrenthold and Juliet Eilperin, 'In E-Mails, Science of Warming Is Hot Debate', Washington Post (5 December 2009).

[4] Reprinted in: 'Don't Fight, Adapt', National Post (12 December 2007), at: http://www.nationalpost.com/news/story.html?id=164002 (10 January 2009).

[5] United States Senate Environment and Public Works Committee (Minority), More than 650 International Scientists Dissent over Man-Made Global Warming Claims (Washington, D.C., US Senate, 2008), at: http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=83947f5d-d84a-4a84-ad5d-6e2d71db52d9 (10 January 2009).

[6] Among many others: Robert M. Carter, C. R. de Freitas, Indur M. Goklany, David Holland and Richard S. Lindzen, 'The Stern Review: A Dual Critique, Part I: The Science', **World Economics** (Vol. **7, No. 4, 2006), pp. 167-98;** Ernst-Georg Beck, '180 Years of Atmospheric CO_2 Gas Analysis by Chemical Methods', Energy & Development (Vol. 18, No. 2, 2007), pp. 259-82; Henk Tennekes, Broeikasramp en Weerbericht (Haarlem:

These arguments deserve to be taken seriously, and not, as has thus far been the case in the global warming-regime, summarily dismissed. At the very least, they demonstrate that the science is far from conclusive, which is hardly surprising given the extraordinarily difficult character of this issue and the newness of the field of climatology.

The policy challenge, after 'Hopenhagen' and 'climate-gate', therefore seems clear: how to devise a realistic set of international and domestic policies that would curb global warming (in case this was happening), while also resolving various other pressing issues (so that these policies would still be worthwhile in case global warming was not taking place)? In this article, I attempt to sketch out such a set of policies.

I. Win-Win

An effective, efficient and equitable solution to the threat of global warming would be based on the following principles. *We need to develop and promote novel technologies and energy resources that do not emit greenhouse gases (and, where possible, solve other environmental problems as well) and that are also cheaper than existing technologies and energy resources. International cooperation should not be overly formal, and should be concerned first and foremost with stimulating such technological change.* In the rest of this article, I argue why this is feasible, how it can be done, and what role international coordination should play. For the moment, please suspend your disbelief and consider the advantages that this plan would bring if it were achievable.

Aramith, 2001); Roger Pielke, Jr., 'Global Cooling May Be Consistent with Global Warming', Prometheus: The Science Policy Blog (30 April 2008), at: http://sciencepolicy.colorado.edu/prometheus/archives/climate_change/001413global_cooling_consi.html (last visited 26 January 2009); Ian Castles & David Henderson, 'The IPCC Emission Scenarios: An Economic-Statistical Critique', Energy & Environment (Vol. 14, Nos 2-3, 2003), pp. 159-185; *Henrik Svensmark & Nigel Calder,* The Chilling Stars: A New Theory of Climate Change *(Thriplow: Icon, 2007)*; 'Statement of Dr. William Gray', US Senate Committee on Environment and Public Works Hearing Statements (Washington, D.C., 28 September 2005), at: http://epw.senate.gov/hearing_statements.cfm?id=246768 (15 January 2009); Richard S. Linzen, 'Taking Greenhouse Warming Seriously', Energy & Environment (Vol. 18, Nos. 7 &8, 2007), pp. 937-50; Robert Mendelsohn, William Nordhaus & Daigee Shaw, 'The Impact of Global Warming on Agriculture: A Ricardian Analysis', American Economic Review (Vol. 84, No. 4, 1994), pp. 753-771; William Nordhaus, **A Question of Balance: Weighing the Options on Global Warming Policies** (New Haven: Yale University Press, 2008); **Bjørn** Lomborg, Cool It: The Skeptical Environmentalist's Guide to Global Warming (New York: Knopf, 2007).

First of all, this proposal would make sense regardless of whether the climate change 'deniers' or the 'alarmists' turned out to be right. Even if it so happened that the present concerns over climate change were greatly exaggerated, then the development of cleaner and cheaper technologies and energy resources would still be beneficial in a myriad of ways. Since it would lower the costs of energy, it would obviously bring about economic advantages. Achieving a renewable revolution would certainly cost a lot of money (for instance to build new infrastructure or fund more research and development). However if successful, then most uses of energy would become cheaper than ever before. This would constitute a never-ending financial benefit. In addition, the scheme would lessen, or even cut entirely, the world's dependence on the oil- and gas-producing countries. This would enable democratic countries to stop supporting tyrannical regimes in the Middle East. It would also serve to reduce the funds that are flowing from oil-rich countries to Jihadist groups (such as Hamas, Hezbollah, Al Qaeda and the Taliban) as well as to radical Islamic mosques and madrassas, thus providing a significant blow to Islamist terrorism. And it would allow European countries to escape from the headlock applied from time to time by gas-rich Russia. Further, this plan would make economies less vulnerable to the whims of oligopolistic energy companies. For technical reasons, fossil energy markets are typically dominated by a small number of suppliers, a phenomenon that tends to drive up the prices of oil, coal and gas, and puts customers at the mercy of suppliers. Being far more varied and small-scale, renewable energy markets are less prone to such oligopolistic practices. Increased use of alternative forms of energy would sometimes also help out with solving other environmental problems, such as acid rain and water pollution.[7] And a renewable revolution would increase employment, as more people are typically needed to produce renewable energy than are required for fossil energy.[8] If feasible –and you have agreed to suspend your disbelief momentarily– then this would be a no-regrets policy that might conceivably win the support of members of the skeptical camp.

In addition, the proposal taken up in these pages would meet all the basic objections that have been made by those who have refused to abide by international targets. The United States, for one, has continuously complained that the costs of curbing climate change are too high. The end of the Bush Presidency has not changed this, as the US Senate has long taken a similar stance. The plan advocated here would assuage these concerns in another way. It would involve an all-out effort to make the fight against the greenhouse effect profitable by lowering the costs of energy.

The leaders of the developing countries, for their part, have pointed out that most greenhouse gases have been released within rich countries, and have

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[7] Daniel Sarewitz & Roger Pielke, Jr., 'Breaking the Global-Warming Deadlock,' The Atlantic Monthly (Vol. 286, 2000), pp. 54-64.

[8] Hermann Scheer, A Solar Manifesto (London: James & James, 2001), pp. 135-36.

protested about the environmental damage that the Northern states have thus unleashed upon the South. These governments (including those of China and India) have also argued that they are too poor, and have to deal with too many other environmental threats, to be able to contribute significantly to any solution of the climate change-issue. If the Northern countries want to prevent the economic growth in the South from contributing massively to global warming, then the former had better start paying up. This proposal pre-empts these objections as well. An all-out attempt to develop cheaper and cleaner energy resources would have to be initiated within affluent countries. One major way in which renewable energy can be made cheaper is by expanding current research and development (R&D) levels. Thus far, almost all energy R&D has been undertaken in rich countries, and only they may have the financial means to significantly increase current budgets. By lowering energy prices through a massive expansion of R&D budgets (among other measures), industrialised countries would already be helping the citizens of the Third World. They could even do more through assisting developing countries in their attempts to 'leap-frog' to the latest technologies. This would entail aiding developing countries to set up their own energy R&D centers, helping them to acquire their own production facilities for renewable energy, providing training and information, *etc*. This show of international solidarity will be even more impressive when one realises that many developing countries stand to benefit more from a renewable revolution than affluent ones do. The development of cheap forms of biomass, solar energy and batteries would negate the need to construct large-scale electricity grids, as it would enable individual households and villages to produce their own energy. This would be a great boon to the vast areas in the developing world that are presently without electricity grids. Furthermore, the many poor countries that receive a lot of sunshine would benefit disproportionately, since solar energy panels would work more efficiently in these regions than in the many affluent parts of the world that are afflicted by cloudy and rainy weather. Last, as can be seen in the rapid expansion of solar panel production in China, a number of developing countries (with their lower labor costs) would stand an excellent chance of becoming major producers of renewable energy technology.[9] In these various ways, the proposal laid out in this article also caters to the wishes of the Southern states.

The proposal would also ease the existing diplomatic tensions by greatly reducing the number of states that have to take part in the initial stages of the struggle against global warming. At the meetings of the United Nations Framework Convention (UNFCCC), an impossibly large number of governments are negotiating with each other. Increasing R&D budgets for

[9] Keith Bradsher, 'China Racing ahead of U.S. in Race to Go Solar', New York Times (25 August 2009), p. A1; Louisa Schaefer, 'Germany's Solar Branch Feels Squeeze from Asian Competitors', DW-World (18 August 2009), at: http://www.dw-world.de/dw/article/0,,4580873,00.html?maca=en-rss-en-all-1573-rdf (last visited 30 August 2009).

energy would not involve a large group of countries, as only nine countries carry out more than 95 percent of the world's energy R&D.[10] Of course, other affluent countries should also do their bit, especially the newly industrialised countries (such as Singapore and South Korea) and developing countries with fast-growing economies (such as India, Brazil and China). Yet, this would still leave a rather limited number of countries.

Moreover, not one of these countries, not even the United States, would be absolutely vital for this effort. A policy that stimulates the search for production processes and for forms of energy that are cheaper and cleaner mixes public with private goods. Its public goods aspect would mean that part of its benefits will accrue to the people who have not pitched in. Lower energy prices and fewer greenhouse gases could benefit all, including those who have not contributed to climate-friendly technology, 'free-riding' from a Northern perspective, and the repaying of a historic debt, so far as the South is concerned. But either way, those countries and companies that have been at the hub of the efforts to stimulate technological change would benefit more than the states and firms that have chosen to remain at the sidelines. In the field of energy there is a clear 'first-mover advantage'. If for instance British Petroleum were to engage in a serious search for renewable energy-resources that are economically viable, and were to be successful at that, then the company would enjoy a tremendous advantage over its slacking competitors in the world's energy markets. This competitive edge would also benefit the citizens of the various countries in which these companies have their main offices and production sites somewhat more than the populations of other places. Two things follow from this. If a country or enterprise decided not to support clean technology, it would not undermine any collective enterprise. Furthermore, governments would be foolish not to climb on board.

In addition, the proposal would reduce the extent to which international agreement on global warming is needed, and would do away with much of the debilitating formality of the ongoing inter-governmental dealings. A focus on technological change would not necessarily require an official international treaty. What would be needed most is a pledge to promote clean technology. This can be done through increasing national R&D budgets, mobilising capital, adapting infrastructure, shifting taxes and subsidies, training installers and maintenance engineers, engaging in a dialogue with firms and citizens' groups, encouraging local governments to organise the production of renewable energy, and the like. As these policies would serve the self-interests of the countries involved, they would not necessitate large amounts of formal international cooperation.

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[10] Paul J. Runci, 'Energy R&D Investment in IEA Countries', Pacific Northwest National Laboratory/Joint Global Change Research Institute Technical Paper PNWD-3581 (Baltimore, MD: Joint Global Change Research Institute, 2005), p. 1, at: http://www.globalchange.umd.edu/data/publications/PNWD-3581.pdf (last visited19 January 2009).

A focus on promoting renewable energy would also narrow the opportunities for the suppliers of fossil fuels to influence decision-making. Since the Kyoto Protocol and its, hoped-for, successor treaty are supposed to be based on unanimity among governments, it is relatively easy for multinationals to block the entire process, as they only need to put pressure on and convince a few governments. However, when a variety of governments and corporations are striving to make renewable energy competitive, fossil energy-companies will somehow have to stop each and every one of these initiatives – as a few successes would already be lethal. Instead of doing simultaneous battle on so many fronts, it would in the end become easier (if not imperative) for these enterprises to join the renewable revolution.

Last, this plan would make 'technology transfer' a much more feasible option. As presently conceived, technology transfer is very much a top-down and highly expensive undertaking. Present plans call for estimates of the future 'technological needs' of developing countries, as well as assessments of how much these countries should receive in compensation for using the latest clean technology.[11] China and the Group of 77 (developing countries) have argued that the industrialised countries should hand over 1.0 percent of their annual gross domestic product (GDP), while the Copenhagen Accord foresees an annual transfer of US$ 100 billion (by 2020).[12] Again, this seems an unrealistic and overly technocratic project. If cheaper and cleaner energy resources and technologies became available, then the governments and companies in the South would have a strong incentive to acquire these themselves. Of course, such technological progress would not be a panacea to encourage the spread of cleaner practices. It would not make the adoption of new technologies and energy resources by Southern companies automatic and instant. A large role for governmental action would still exist, in the form of capacity-building, demonstration projects, spreading the word, adapting institutions and infrastructure, providing credit, and so on. Development assistance could, and should, support these actions. But the diffusion of clean technology would be a lot easier under this scheme, as it would be in the financial interest of companies and governments everywhere to employ the latest technology.

By now, it will hopefully be clear that it is imperative to achieve widespread technological progress. This leaves at least one big question hanging in the air: is it possible to develop new technologies and energy resources that do not emit greenhouse gases and that are cheaper than the already existing alternatives?

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[11] See, for instance, Global Environmental Facility, 'Report of the Global Environment Facility on a Strategic Programme to Scale up the Level of Investment for Technology Transfer', FCCC/SBI/2008/5 (Bonn: UNFCCC, 2008), at: http://unfccc.int/resource/docs/2008/sbi/eng/05.pdf (19 January 2009).

[12] 'West Told to Keep Its Promises on Tech Transfer', China Daily (29 October 2008), at: http://china.org.cn/environment/news/2008-10/29/content_16682184.htm (21 January 2009).

II. The Rise of the Renewables

Many opportunities to create 'win-win' situations abound in the attempt to prevent global warming. A lot of money can instantly be saved through increasing energy efficiency. Households can spare the climate and their purses by doing such simple things as switching to double glazing and fluorescent light bulbs. The culmination of such thrift would be the impressive 'Passivh***äuse***r' (passive houses) that were pioneered in the German state of Hessen, and are currently spreading around the world. These houses use an absolute minimum of energy (less than 25 percent as compared to normal houses) through the ingenious use of passive solar heating, body heat, waste heat from lighting and other electric appliances, airtightness, triple pane insulation, and ventilation systems. Their construction does not cost more than standard housing, while they generate sufficient heat even for particularly cold parts of the world such as Scandinavia.[13] Amory Lovins and his colleagues at the Rocky Mountain Institute have long documented the profits that companies could reap from a more efficient use of energy and other natural resources.[14] Both companies and households therefore have a variety of opportunities to cut costs and the use of energy.

But renewable energy resources, such as solar, water, geothermal, biomass, and wind energy offer the greatest opportunities to turn the fight against global warming into a lucrative business. Their prices have come down considerably in recent years.[15] Wind energy is poised to become fully

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[13] Elizabeth Rosenthal, 'No Furnaces but Heat Aplenty in "Passive Houses"', New York Times (27 December 2008), p. A1. See also the websites of the US Passive House Institute and the German Passivhaus Institut, at: http://www.passivehouse.us/passiveHouse/PHIUSHome.html (22 January 2009), and http://www.passivhaustagung.de (22 January 2009).

[14] Paul Hawkins, Amory Lovins & L. Hunter Lovins, Natural Capitalism: Creating the Next Industrial Revolution (Boston, MA: Back Bay Books, 2008), pp. 11-12.

[15] A wide variety of organisations and professionals have shown that the costs of renewable energy have fallen dramatically during the last few decades. These include: the US Department of Energy; the International Energy Agency; UNDP, UNDESA and the World Energy Council; the Fraunhofer Institute for Solar Energy Systems; the Renewable and Appropriate Energy Laboratory at the University of California at Berkeley, Vijay V. Vaitheeswaran (the environment and energy-correspondent for The Economist); the G8 Renewable Energy Task Force, and the Renewable Energy Policy Network for the 21st Century. See: National Renewable Energy Laboratory, Choices for a Brighter Future: Perspectives on Renewable Energy (Golden, CO: US Department of Energy, 1999), at: http://www.nrel.gov/docs/fy99osti/26716.pdf (22 January 2009); NREL Energy Analysis Office, 'Renewable Energy Costs Trends', Powerpoint Presentation (Golden, CO: US Department of Energy, 2002), at: www.nrel.gov/analysis/docs/cost_curves_2002.ppt *(22 January 2009);* International Energy Agency, Experience Curves for Energy Technology Policy (OECD/IEA, Paris, 2000); Thomas B. Johansson and José Goldemberg (eds), World Energy Assessment 2004 (New York: UNDP, UN-DESA and the World Energy Council, 2005), at: http://www.undp.org/energy/weaover2004.htm (22 January 2009); Eicke R. Weber, 'Where Are We Heading', Presentation (Singapore: Semicon, 6 June 2008), at:

competitive. State-of-the-art wind plants currently produce electricity at about $0.05 per kilowatt-hour (kwh), or six times as efficiently than was the case in 1980. This means that only the breadth of a hair now separates the costs of wind energy from the expenses incurred when using other forms of energy. And expectations are that –due to the development of more efficient rotor blades and the benefits of large-scale production– the costs of wind energy will continue to fall.[16] Hydro energy is making a strong come-back after the disastrous experiences with building mega-dams in a variety of poor countries during the 1970s and 1980s.[17] In many parts of the world, water has long offered an inexpensive and reliable source of energy. All of Norway's electricity needs are provided for in this way. But many of the huge water dams that were built in the past ruined ecosystems and forced large amounts of people off their lands. The latest hydro-plants also come in small and medium versions, and can be located in places where they do not severely affect ecosystems. This has greatly increased the attractiveness of water energy.[18] Energy from geothermal sources (*i.e.* heat from the earth) has steadily become cheaper as well.[19] Its production costs have decreased 25 percent over the past two decades and currently come to $0.05-0.08 per kwh. This means that geothermal energy is very close to being competitive with fossil fuels. Moreover, the US Energy Department, working in tandem with the geothermal industry, has pledged to reduce the costs of geothermal to a mere $0.03 per kwh in the next decade. This would make geothermal energy cheaper than fossil fuels (given the stagnant production costs of the latter).[20] Both forms of solar energy have also come a long way. Solar thermal energy uses the heat provided by the sun to generate electricity and heating. Since 1980, production costs have come down from $0.40 to around $0.08 per kwh, and are widely expected to keep falling. One major advantage is that

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http://www.ise.fraunhofer.de/veroeffentlichungen/ausgewaehlte-vortraege-und-artikel/vortraege-weber/where-are-we-heading (22 January 2009); Antonia Herzog, Timothy Lipman, Jennifer Edwards, and Daniel Kammen, 'Renewable Energy: A Viable Choice', Environment (Vol. 43, No. 10, 2001), pp. 8-20; Vijay V. Vaitheeswaran, Power to the People (New York: Farrar, Straus and Giroux, 2003); and Corrado Clini and Sir Mark Moody-Stuart, G8 Renewable Energy Task Force: Final Report (2001) at: http://www.g8.utoronto.ca/meetings-official/g8renewables_report.pdf (22 January 2009); and REN21, Renewables 2007: Global Status Report (Paris: REN21, 2008), p. 14, at: http://www.ren21.net/pdf/RE2007_Global_Status_Report.pdf (22 January 2009).

[16] Martin Junginger, Andre Faaij & Wim Turkenburg, 'Global Experience Curves for Wind Farms', Energy Policy (Vol, 33, No. 2, 2003), pp. 133-50.

[17] These disasters are documented in Rich, op. cit.; the Morse Commission, Sardar Sarovar: Report of the Independent Review (Ottawa: Resource Futures International, 1992); and Dipak Gyawali, Water in Nepal (Kathmandu: Himal Books, 2001).

[18] Oliver Paish, 'Small Hydro Power: Technology and Current Status', Renewable and Sustainable Energy Reviews (Vol. 6, No. 6, 2002), pp. 537-56.

[19] It needs to be noted that it is debatable whether geothermal energy is renewable. On the one hand, the source of energy itself is eternal, while on the other the specific production sites can only operate for a certain period of time. The same sometimes applies (due to sedimentation) to hydro facilities.

[20] US Department of Energy, Choices for a Brighter Future, op. cit., p. 7. On the same page, this department reports that geothermal energy has the potential to supply as much as 50 percent of America's electrical power needs.

this renewable energy source can easily be transported over long distances, for instance from the deserts of North Africa to Southern and Western Europe. Photovoltaic (PV) solar energy does not rely upon the heat emanating from the sun, but instead transforms daylight into electricity. Hence this second type of solar energy can also be produced when it is cloudy (although production is more efficient, and therefore cheaper, under sunny conditions). The costs of generating electricity with PV solar cells have been reduced by a factor of seventy (*sic.*) during the last twenty years. It is already profitable to solely rely on photovoltaic energy in many poor, but sunny, areas.[21] This is possible, as the use of photovoltaics enables these areas to avoid the construction of an electricity grid. Moreover, anywhere in the world, photovoltaic systems to generate heat and power can serve as walls and roofs of houses. The costs of doing so are usually not much higher than the costs of using traditional construction materials. In addition, the resulting energy costs for households are lower. This novel way of constructing houses is therefore already cost-effective in many regions.[22] Admittedly, a further three- or fourfold cost reduction will be needed to make solar energy fully competitive in all parts of the world and for all possible appliances. But the tremendous reduction that has already been achieved during the last two decades strongly suggests that this is feasible. As PV technology is still constantly being improved (in particular with the introduction of thin film technology) and many scale benefits remain to be reaped, great expectations exist for making PV energy cheaper than fossil energy.

In the transport sector, things have also been moving fast. Hybrid cars, which partly run on electricity, have become hugely popular in recent years, especially the Honda Civic Hybrid and the Toyota Prius. The latter two brands are fuelled by gasoline as well. But hybrid cars can also combine electricity with other sources of energy, such as diesel, natural gas or biofuel. Hybrids are often economical, as their higher purchase prices are typically offset by lower fuel costs within not more than five years.[23] Fully electric cars are around the corner as well. Indeed some of them have already arrived, such as the Tesla Roadster sports car from California, Think's City from Norway, and REVA's G-Wiz from India. The more established car manufacturers are currently scrambling to get on the bandwagon: Renault-Nissan, General Motors, Toyota, Ford, BMW, Volkswagen and Daimler are all searching for ways in which to mass-produce affordable electric cars. In

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[21] Wendy Parker, Rolf Oldach & Alison Wilshaw, 'PV for Rural Electrification in Developing Countries: Programme Design, Planning and Implementation', Report IEA PVPS Task 9 (St. Ursen: International Energy Agency-Photovoltaic Photovoltaic Power Systems, 2003).

[22] Hermann Scheer, 'Unerschöpflich und sauber: Solarthermische und photovoltaische Energien,' AgV Forum (Vol. 1, 2000), at: http://www.niveatown.org/GrafikenNivea36/AgV_Text.PDF (28 January 2009).

[23] US Department of Energy and US Environmental Protection Agency, 'Fuel Economy Guide', DOE/EE-0325 (Washington, DC: Department of Energy and EPA, 2009), p. 19, at: http://www.fueleconomy.gov/feg/FEG2009.pdf (27 January 2009).

order to be able to do so, battery and/or fuel cell technology will need to be improved. But car manufacturers believe this to be possible within the next ten to fifteen years.[24] To the extent that they are charged by renewable energy, or fuelled by hydrogen, electric cars do not emit greenhouse gases.

Still, the electric car is not the only horsepower on which companies are betting. Biofuel (*i.e.* fuel produced from recently living organisms) can be fed to vehicles with internal combustion engines. The costs of biofuel have been halved during the last two decades and are expected to dwindle to the production cost of gasoline in some ten to fifteen years time. Moreover, biofuel could be used in planes and ships as well. In 2006 billionaire Richard Branson pledged to dedicate the future profits of two of his companies (Virgin Atlantic and Virgin Trains) to developing and commercialising a biofuel alternative for planes, among other purposes.[25] Even though all this may look promising, in 2007 the International Monetary Fund (IMF), Food and Agricultural Organisation (FAO) and other organisations began to hold the use of biofuel responsible for an assortment of ills: rising food prices (as corn once grown for food was increasingly sold on biofuel markets), riots and hunger around the world (allegedly caused by rising food prices), destruction of old forests (as these were flattened to make way for sources of biofuel), and climate change (as plants and trees used for biofuel were not grown in a sustainable manner).[26] Though some of these claims seemed dubious (such as the notion that the increased use of biofuels led to civil unrest in Haiti – a country long known for corruption, nepotism and street violence), it is vital that the downsides of biofuel are carefully considered. But it is equally important to acknowledge that biofuel comes in many versions, most of which are still undergoing rapid development. Some types of biofuel (such as corn-based ethanol or palmoil) may indeed turn out to have prohibitive side-effects, but others (for example, biofuel from

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[24] Peter Valdes-Dapena, 'Electric Cars and the Future of Detroit', CNNMoney.Com (10 December 2008), at: http://money.cnn.com/2008/12/04/autos/bailout_hybrids/index.htm (28 January 2009); Ken Bensinger, 'Batteries are Seen as Key to Future of Electric Vehicle Market', Los Angeles Times (13 January 2009), at: http://www.latimes.com/news/science/environment/la-fi-batteries13-2009jan13,0,158845.story?track=rss (28 January 2009); Byoungwoo Kang and Gerbrand Ceder, 'Battery Materials for Ultrafast Charging and Discharging', **Nature** (Vol. 458, No. 7235, 2009), pp. 190-93; David Fierce, 'Electric Cars to Become Profitable, Car Manufacturers Say', Eflux Media (28 January 2009), at: http://www.efluxmedia.com/news_Electric_Cars_to_Become_Profitable_Car_Manufacturers_Say_34040.html (28 January 2009).

[25] Andrew C. Revkin, 'Branson Pledges Billions to Fight Global Warming', New York Times (21 September 2006), at: http://www.nytimes.com/2006/09/21/science/22warmcnd.html (28 January 2009).

[26] Food and Agriculture Organization, The State of Food and Agriculture Report, 2008 (Rome: FAO, 2008); UN-Energy, Sustainable Bio-Energy: A Framework for Decision-Makers (Rome: FAO, 2007); Grant Ferrett, 'Biofuels "Crime against Humanity"', BBC News (27 October 2007), at: http://news.bbc.co.uk/2/hi/americas/7065061.stm (29 January 2009).

sugarcane, algae, cellulosic biomass or genetically engineered micro-organisms) may become widely used in cars, boats and planes.[27]

Even if biomass were not to work out, other clean alternatives to oil might. In Southern France a small company led by a former Formula One-engineer has been designing a car that runs entirely on compressed air. MDI, as the company is called, claims that this car will be able to reach a maximum speed of 110 kilometers (km), will have a range of 300 km and can be recharged in three minutes. The costs of recharging would only come to a few dollars. Indian industrial giant Tata Motors has entered into a joint venture with MDI, and will soon start selling hybrid versions of this car. MDI itself has announced that it will start selling 'pure' versions in France by the end of 2009.[28] If these efforts were successful, then a major technological break-through (with far-reaching economic, political and geostrategic implications) would be achieved.

Not all countries have equal endowments of renewable energy sources. Some regions have more wind, others more intensive daylight, yet others more geothermal sources or more water power. The renewable energy mix that can be tapped in to differs from country to country, and even from locality to locality. But virtually all parts of the world will be able to fulfill their needs for electricity and transport with the help of renewables.[29]

At this point several widely dispersed counter-arguments often pop up which need to be addressed. Critics routinely argue that the production of renewable energy would take up too much space. This argument often overlooks that the production facilities for fossil energy also occupy a lot of territory. Just think of the large swaths of land that coal mines, oil fields and refineries and nuclear reactors gobble up. Plus, a distinct advantage of

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[27] Marcelo E. Dias de Oliveira, Burton E. Vaughan & Edward J. Rykiel, Jr., 'Ethanol as a Fuel: Carbon Dioxide Balances, and Ecological Footprint', BioScience (Vol. 55, No. 7, 2005), pp. 593-602; **J.L. Fortman, Swapnil Chhabra, Aindrila Mukhopadhyay, Howard Chou, Taek Soon Lee, Eric Steen & Jay D. Keasling**, 'Biofuel Alternatives to Ethanol: Pumping the Microbial Well', Trends in Biotechnology (Vol. 26, No. 7, 2008), pp. 375-81; David Biello, 'Biofuel of the Future: Oil from Algae', Scientific American (October 2008), at: http://www.sciam.com/article.cfm?id=biofuel-of-the-future (28 January 2009); Lee R. Lynd, Mark S. Laser, David Bransby; Bruce E. Dale, Brian Davison; Richard Hamilton; Michael Himmel; Martin Keller; James D. McMillan, John Sheehan, Charles E. Wyman, How Biotech Can Transform Biofuels', Nature Biotechnology (Vol. 26, No. 2, 2008), pp. 169-72; **Arthur J. Ragauskas, Charlotte K. Williams, Brian H. Davison, George Britovsek, John Cairney, Charles A. Eckert, William J. Frederick, Jr., Jason P. Hallett, David J. Leak, Charles L. Liotta, Jonathan R. Mielenz, Richard Murphy, Richard Templer & Timothy Tschaplinski, 'The Path Forward for Biofuels and Biomaterials', Science (Vol. 311, No. 5760, 2006), pp.** 484-89.

[28] Swaraj Baggonkar, 'Air Car May Blow in Next Year', Business Standard (11 January 2009), at: http://www.business-standard.com/india/news/air-car-may-blow-in-next-year/00/01/345831/ (28 January 2009).

[29] Scheer, A Solar Manifesto, op. cit., chapter 5; S**tephen Pacala and Robert Socolow,** 'Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies', Science (Vol. 305. No. 5686, 2004), pp. 968-72.

renewable energy is that it can usually be taken down as fast as it was set up. When at some point in the future solar energy becomes competitive, then it will not be overly time-roving or expensive to dismantle existing wind parks. In contrast, nuclear reactors will remain too radioactive to deconstruct for thousands of years. Abandoned mines often lay waste as well. In the Western United States along some 100,000 to 500,000 former mine sites are believed to exist, many of which pose safety and environmental hazards.[30]

In addition, it is often asserted that renewable energy is intermittent, and therefore unreliable. (Familiar complaints include: "at night, the sun does not shine" and "the wind does not always blow".) Fortunately, these assertions are also not valid. The intermittent nature of renewable energy can be overcome by: (1) relying upon a variety of alternative renewables, (2) combining the power generated by wind parks from different locations, (3) the possibility to transport solar energy, geothermal energy, biomass, and hydrogen over large distances, (4) further improving the technology of storage batteries, and (5) phasing in 'smart electricity grids' (which inform customers about the cheapest times to use energy, and also allow customers to feed self-generated electricity into the grid, among other things). The Spanish regions of Galicia and Castile y León derive 70 percent of their electricity from a variety of renewable sources. Their examples illustrate what is possible. Moreover, the supply of fossil energy is not very reliable either (albeit for different reasons). One only needs to remember the 1973 oil embargo by Arab states of the United States and the Netherlands, or the power games that the Russian government has been playing with the countries that are dependent on its gas, to realise how intermittent fossil energy can be.

Wind energy is frequently lamented for the environmental hazards that it supposedly leads to. Windmills, it is said, alter landscapes and kill birds as well. The former complaint can be met whenever it is possible to build wind farms offshore (where the higher construction and maintenance costs are partly offset by stronger and steadier winds). The latter lament can somewhat be pre-empted by not locating wind farms on routes frequented by migratory birds. Most importantly though, one needs to realise the choice that is at stake. If our electricity needs are not nourished by renewable energy, then they are likely to be met by fossil energy. The ecological problems caused by the use of renewable energy pale into comparison with the air pollution, oil spills, deforestation and other environmental ills that fossil energy brings about. The replacement of fossil and nuclear with renewable energy would also allow a drastic cut in the consumption of water, as today's large power plants guzzle up enormous amounts of water (around 75 percent of all water use in Germany and 50 percent in the United States).[31]

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[30] According to the Bureau of Land Management of the US Department of the Interior, at: http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/frequently_asked_questions.html (29 January 2009).

[31] Scheer, Energy Autonomy, op. cit., p. 39.

But perhaps the most frequent complaint is that a shift to renewable energy will be too expensive and will require too many subsidies. This argument neglects to consider that fossil fuels and nuclear energy have always been heavily subsidised – to the tune of $167 billion to $250 billion per year.[32] Subsidies for renewable energy have remained a fraction of this figure.[33] Further, the argument forgets to raise the question: too expensive for whom? Suppliers of fossil energy have exploited their oligopolistic market positions to inflate energy prices and profits. In the last ten to fifteen years, the prices of oil and gas have multiplied, without much of a protest from those who oppose renewable energy.[34] Renewable energy markets will always be more decentralised and competitive, and therefore less prone to lead to windfall profits – to the benefit of energy users. Last, this criticism tends to get fixated on the current production costs of renewable energy, ignoring the immense cost reductions that have already been achieved in recent decades. The rise of the renewables is all the more impressive given the low priority these energy resources have been given over the years. From the mid-1970s onwards, 68 percent of *all* energy R&D undertaken around the world was spent on developing nuclear and fossil energy. In sharp contrast, a meager 9 percent was used to support renewable energy.[35] As we now know, the nuclear industry has not been able to offer convincing answers to the questions of what to do with nuclear waste, and how to clean up nuclear plants that are no longer in use. In addition, nuclear energy remains a rather expensive option (more so than many current wind parks).[36] As a consequence, nuclear energy has widely been rejected in both North America and Western Europe. It would indeed not be far-fetched to believe that we would never have found ourselves into the current mess in the first place, or at least not to this degree, if the great majority of the world's energy R&D had not been used to fatten the white elephant called nuclear energy. A more balanced allocation of funds would surely have made the renewables much cheaper by now.

Surprisingly perhaps, this misallocation of funds has still not been rectified. In 2007 only some 12 percent of global energy R&D was sprinkled on

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[32] André de Moor, 'Towards a Grand Deal in Subsidies and Climate Change', Natural Resources Forum (Vol. 25, No. 2, 2001), pp. 167-76; José Goldemberg, 'The Promise of Clean Energy', Energy Policy (Vol. 34, No. 15, 2006), p. 2188; Trevor Morgan, **Reforming Energy Subsidies: Opportunities to Contribute to the Climate Change Agenda (Nairobi: UNEP, 2008).**

[33] Bert J.M. de Vries, **Detlef P. van Vuuren & Monique M. Hoogwijk, '**Renewable Energy Sources: Their Global Potential for the First-Half of the 21st Century at a Global Level – An Integrated Approach**', Energy Policy (**Vol. 35, No. 4, 2007), p. 2607.

[34] Shahriar Shafiee & Erkan Topal, 'An Econometrics View of Worldwide Fossil Fuel Consumption and the Role of the US', Energy Policy (Vol. 36, No. 2, 2008), pp. 779-80.

[35] Figures taken from the R&D Statistics database of the International Energy Agency, at: http://www.iea.org/Textbase/stats/rd.asp (28 January 2009).

[36] **Ralph E. H. Sims, Hans-Holger Rogner & Ken Gregory, '**Carbon Emission and Mitigation Cost Comparisons between Fossil Fuel, Nuclear and Renewable Energy Resources for Electricity Generation**', Energy Policy (**Volume 31, No. 13, 2003), p. 1321.

renewable energy, whereas 49 percent was lavished on nuclear and fossil energy.[37] On the bright side, this misallocation strongly suggests the tremendous potential that renewable energy holds. Starved of funds, the renewables have already gained considerable ground. With a more substantial dose of financial fertilizer, they will bloom.

Combating climate change will certainly not be painless. A lot of money will have to be spent on breaking our allegiance to fossil fuels, and some industries and regions will suffer and decline as a result. Much infrastructure will need to be changed, and this will be expensive too. But if it were possible to make renewable energy resources cheaper than fossil fuels, and to adapt our modes of transport and production to these novel forms of energy, then we would save ourselves a literally unending stream of money. This point has been overlooked by those who have estimated that the costs of curbing global warming will range in the trillions of dollars.[38] Yet it remains fully attainable to sink the costs of renewable energy below the costs of energy generated from fossil fuels through a process of 'creative destruction'.[39] As even the International Energy Agency (a traditional ally of fossil energy-producers) now admits, this is a realistic goal in view of the impressive progress that the renewables have already made during the last twenty years – against all odds.[40]

III. Unleashing the Renewable Revolution

The rise of the renewables might perhaps suggest that market processes by themselves will prevent any human-made global warming. It appears that in five to fifteen years many forms of renewable energy will have become competitive with, or even cheaper than, fossil fuels, which will then set off a rapid increase in the use and production of renewable energy. The catch is that all the major energy and oil companies have made massive investments in the production of fossil fuels. These enterprises would like to see a full return on these investments, and therefore face a strong temptation to stall the switch to renewable energy. They could do so by refusing to throw their financial might and expertise behind the further development and production of renewable energy. Another way would be by lobbying policy-makers so as to keep existing subsidies for fossil fuels intact. A Green Party member of the European Parliament, Claude Turmes, put it starkly:

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[37] Figures taken from the R&D Statistics database of the International Energy Agency, at: http://www.iea.org/Textbase/stats/rd.asp (28 January 2009).

[38] E.g., United Nations Framework Convention on Climate Change, 'Investment and Financial Flows to Address Climate change: An Update', Technical Paper FCCC/TP/2008/7 (Geneva: United Nations Office, 2008); Economic Affairs Committee, The Economics of Renewable Energy (London: House of Lords, 2008).

[39] On 'creative destruction', see Joseph A. Schumpter, Capitalism, Socialism and Democracy (New York: Harper & Row, 1942), pp. 81-86.

[40] This is the conclusion reached in all the publications listed in note 55 (including one by the IEA).

> "Europe's biggest problem [is] that we have seven electricity producers who control 60 percent of production, 70 percent of the entire European network, and 95 percent of compensation of current in Europe. The people who sit on coal and nuclear energy power plants will simply not allow a shift to renewable energy."[41]

Even though increasing amounts of capital have begun to pump into the development and production of renewable energy (for instance by Silicon Valley entrepreneurs), much more is still needed. In light of the strong opposition from the suppliers of fossil fuels, the renewable energy revolution will only be sparked off when governments actively support it.[42] They have many means at their disposal to do so.[43]

Right away governments should vastly increase their expenditures on renewable energy R&D. A couple of principles need to be followed when doling out this extra money. First, increased public funding should not diminish private investments in renewable energy R&D. Second, it is vital not to put all public eggs into one basket. This was the principal mistake of post-war energy policy around the world, gambling everything on nuclear energy. A wide variety of renewable energy resources and novel technologies should be supported. Forms of energy and technology that would not only be climate-friendly, but would alleviate other environmental problems as well, should be promoted in particular.[44] Third, it is imperative not to channel all public funds through a single department or organisation. Allowing a diversity of ministries and international organisations to allocate funds for energy R&D would be another check on organisational myopia.

Governments can also do much to stimulate private investments in energy R&D.[45] If governments want to promote innovation within firms and sectors, they have to temporarily allow for a minimum of 'sheltered competition'. In the energy markets, governments can offer such shelter to enterprises that are developing renewable energy resources by shifting taxes,

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[41] Scheer, Energy Autonomy, op. cit., p. 172.

[42] Robert Margolis & Jarett Zuboy, 'Nontechnical Barriers to Solar Energy Use: Review of Recent Literature', Technical Report NREL/TP-520-40116 (Golden, CO: National Renewable Energy Laboratory, 2006).

[43] Joanna I. Lewis & Ryan H. Wiser, 'Fostering a Renewable Energy Technology Industry: An International Comparison of Wind Industry Policy Support Mechanisms', Energy Policy (Vol. 35, No. 3, 2007), pp. 1844-57; **Valentina Dinica, '**Support Systems for the Diffusion of Renewable Energy Technologies: An Investor Perspective**',** Energy Policy (Vol. 34, No. 4, 2006), pp. 461-80; Reinhard Haas et.al., 'How to Promote Renewable Energy Systems Successfully and Effectively', Energy Policy (Vol. 32, No. 6, 2004), pp. 833-39.

[44] Sarewitz & Pielke, Jr., op. cit.

[45] See Arie Rip & René Kemp, 'Technological Change,' in Steve Rayner and Elizabeth L. Malone (eds), Human Choice & Climate Change, Volume 2: Resources and Technology (Columbus, OH: Batelle Press, 1998); Roald Suurs, 'Motoren van Duurzame Innovatie' (PhD Dissertation: University of Utrecht, 2009).

offering subsidies, revamping infrastructures, arranging credit, assisting in the training of craftsmen who can install and repair solar energy, encouraging the formation of agricultural cooperatives to produce biomass, helping to forge coalitions between interested parties (such as car-manufacturers, suppliers of biomass and hydrogen, and outlet points), and perhaps even given some temporary financial guarantees to those companies that want to produce photovoltaic energy at an adequate scale. Given the large pool of opportunities to make clean sources of energy economically viable, these government measures would offer quite a few enterprises strong financial incentives to plunge headlong into the development of renewable energy resources. An example of an effective domestic policy is the German Renewable Energy Sources Act from 2000, which has greatly increased the production of renewable energy through the establishment of minimum prices for feeding electricity from renewable sources into the national grid.[46]

Thus, a snowball-effect can be created. When it becomes clear that certain companies are well on their way to developing and deploying clean technologies and energy resources that are cheaper than existing dirty alternatives, then a mad rush to imitate will follow. For clear-cut financial reasons, it will be imperative for sluggish competitors to scramble upon the bandwagon. If British Petroleum (BP) were to finally take its boast to move 'Beyond Petroleum' seriously, and started to conquer the world's markets with cheap renewable energy, then the other established energy producers would have to follow suit or perish. And if BP and the other producers of fossil energy were not inclined to do so, then their hand would eventually be forced by increased competition from renewable energy companies such as Denmark's Vestas or China's Suntech. The same would apply at the country-wide level. If the oil-producing countries realised that other states are sincerely committed to developing affordable and clean energy, then they would have to quickly develop cheap methods to decarbonise fossil fuels, or invest heavily in other forms of energy, or else fall behind on??? the competition. Along these lines, a tiny snowball made up of a few companies and sectors here and there could grow in size very quickly, and have a tremendous impact.

The policies that are needed to a large extent consist of domestic programs that induce firms to invest in renewable energy. These policies would serve the financial self-interests of the countries pursuing them – even if other states did not follow suit. Still, their impact would be greatest if at least a handful of industrialised countries (such as Germany, the United Kingdom, Spain, Japan and California) would simultaneously pursue such policies. Routine coordination and consultation between civil servants of the ministries involved would usually suffice to form this critical mass.

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[46] **Rolf Wüstenhagen** & Michael Bilharz, 'Green Energy Market Development in Germany: Effective Public Policy and Emerging Customer Demand', Energy Policy (Vol. 34, No. 13, 2006), pp. 1681-96.

Other forms of international cooperation would also be helpful. Within the European Union (EU) for instance, the construction of a regional 'smart electricity grid' might be necessary so as to enable the bundling of renewable energy sources from different countries (which would help overcome the intermittent nature of renewable energy).[47] Another major role for international cooperation lies in assisting developing countries to acquire low-cost technologies and energy resources that do not emit greenhouse gases. Rich countries should help poor ones to gain information about the new technologies and forms of energy. Furthermore, developing countries should be assisted in making the institutional and infrastructural changes that will allow them to tap their vast renewable energy resources. Yet again diversity should be the watchword. A patchwork of governmental and private organisations should be involved in technology transfer. Multilateral as well as bilateral forms of cooperation should be encouraged. The developing countries are so diverse and numerous that a single, universal transfer mechanism would undoubtedly fail. The Global Environmental Facility, administered by the World Bank, United Nations Development Program and United Nations Environment Program, should therefore only play a limited role.

Last, it might be helpful if the Organisation for Economic Co-operations and Development (OECD) countries agreed on stringent goals for the reduction of greenhouse gases. But these goals should then be seen as targets that government will strive to reach, and not as legally binding international agreements. In this way, the legal bickering that typically befuddles international treaties could be skipped. It would also allow for the formulation of much more ambitious goals than has thus far been the case. Having such a set of strict international norms would stimulate technological change. Technological innovation is an inherently risky process. It is therefore crucial to those who are contemplating investing in new technologies that the authorities will not waver in their support of these technologies. A strict international agreement on the reduction of greenhouse gases would flag to enterprising firms that the governments were serious about switching to renewable energy. But such an international treaty would certainly not be necessary.[48] As contrary to the reasoning behind the Kyoto Protocol, domestic policies to promote renewable energy are in the medium-run financial interests of the countries pursuing these policies.

Conclusion

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[47] European SmartGrids Technology Platform, 'Vision and Strategy for Europe's Electricity Networks for the Future', EUR 22040 Report (Brussels: European Commission Directorate for Research, 2006), at: http://ec.europa.eu/research/energy/pdf/smartgrids_en.pdf (16 February 2009).

[48] Steve Rayner & Elizabeth L. Malone, 'Ten Suggestions for Policymakers', in Steve Rayner and Elizabeth L. Malone (eds), Human Choice & Climate Change, Volume 4: What Have We Learned? (Columbus, OH: Batelle Press, 1998); Gwyn Prins & Steve Rayner, 'Time to Ditch Kyoto', Nature (Vol. 449, 2007), pp. 973-75.

Proponents of the Kyoto Protocol have long argued that it is vital to negotiate a similar successor treaty, as "there is no alternative".[49] Even after the implosion of the Copenhagen conference UN officials, EU leaders, the government of Mexico (host of the next Conference of the Parties) and representatives of environmental organisations have stuck to this line.[50] Fortunately, they are wrong. A set of domestic and international policies aiming to make a great variety of renewable sources of energy cheaper than fossil energy would not only be a far more realistic strategy for combating global warming, it would also enable governments to achieve a number of other, unrelated economic, political and social goals. Hence, this strategy would still be beneficial even if the current concerns over climate change turned out to be unwarranted after all. Let, therefore, the renewable revolution begin!

[49] For instance Benito Müller, Axel Michaelova & Christiaan Vrolijk, Rejecting Kyoto: A Study of Proposed Alternatives to the Kyoto Protocol (London: Climate Strategies, 2001).
[50] 'EU Lashes out as Climate Discord Deepens', AFP (22 December 2009); 'UN Climate Chief Urges Avoiding Blame over Summit', Associated Press (23 December 2009); 'Mexico Wants Binding Climate Accord at 2010 Summit', Associated Press (24 December 2009); 'Greenpeace Will Keep up Pressure on Global Warming', Associated Press (24 December 2009).