Sustainable Development: Promoting Progress or Perpetuating Poverty?
edited by Julian Morris
published by Profile Books, London, August 2002

Chapter 9

Energy for Sustainable Development

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Energy from hydrocarbons (coal, oil, gas) has contributed hugely to the economic development of the world. But some argue that a hydrocarbon-based energy economy is inherently unsustainable and have called for extreme restrictions on the use of hydrocarbons, as well as the promotion of alternatives. How might the world move towards a more sustainable energy future? Would alternatives to hydrocarbons be more sustainable? The facts show that hydrocarbon energy is becoming ever more sustainable both economically and environmentally. This chapter presents these facts and then makes the case that the *real* energy sustainability issue is intervention by the state, which has entrapped 1.6 billion persons in energy poverty.

Energy: The Master Resource

Energy has been called the *master resource*. As Julian Simon explained,

> "Energy is the master resource, because energy enables us to convert one material into another. As natural scientists continue to learn more about the transformation of materials from one form to another with the aid of energy, energy will be even more important. Therefore, if the cost of usable energy is low enough, all other important resources can be made plentiful."[1]

The modern energy era has contributed to the decline of child labour and slavery, the emancipation of women, industrialisation, and, ultimately, the deferral of death.[2] Going forward, the Brundtland Commission stated,

> "Energy is necessary for daily survival. Future development crucially depends on its long-term availability in increasing quantities from sources that are dependable, safe, and environmentally sound."[3]

Increasing use of affordable energy was considered an anathema in the earlier days of the modern environmental movement. "Sustainability" once meant curtailing energy use to reduce the human imprint on the environment. "Environmental deterioration and energy consumption go hand-in-hand," argued Paul Ehrlich and Anne Ehrlich in 1974.[4] During this period, both the Ehrlichs and John Holdren argued for an energy transfer from developed to the underdeveloped nations, combined with fundamental lifestyle changes, to stretch scarce energy resources.[5] High taxes on hydrocarbon fuels, they argued, could be used to discourage consumption in developed countries and, at the same time, fund Third World growth.

Since then, however, developed countries have become even more dependent on modern, reliable energy. Electricity in the Internet age must be especially regular and dependable. New uses of

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[1] Simon (1996), p. 162.
[2] See, for example, Linden (1997), p. 14; Amory Lovins (1975), p. 3.
[3] WCED (1987), p. 168.
[4] Ehrlich and Ehrlich (1974), p. 40.
[5] Ehrlich et al. (1973), p. 279; Bradley (2000), pp. 21-22, 126-49.

electricity are increasing overall consumption even as efficiency gains reduce energy consumption per application. Consumers and voters consider higher energy prices a problem, not a means to a greater good.[6,7]

Even many mainstream environmentalists who question the sustainability of the modern hydrocarbon-based energy economy now acknowledge the benefits of affordable and plentiful energy for both sides of the economic divide. "A reliable and affordable supply of energy," John Holdren recently stated, "is absolutely critical to maintaining and expanding economic prosperity where such prosperity already exists and to creating it where it does not."[8] In their 1996 book *Betrayal of Science and Reason*, the Ehrlichs warned against "taking action on the basis of worst-case prognoses" by imposing fuel rationing and high energy taxes.[9]

Tragically, most of the world's poorest people continue to be denied access to high-quality, low-cost energy. Wood and dung account for approximately 25 percent of domestic energy consumption in China, but in most of Asia (including India, the second most populous country in the world), the proportion is over 75 percent.[10] The situation in Africa is similar. Proponents of 'renewable' energy euphemistically refer to wood and dung as 'biomass' and suggest that these old technologies might be desirable alternatives to coal, oil, gas, and electricity. In reality, primitive biomass is highly polluting,[11] inefficient, expensive[12] and toxic.[13]

Availability, Flexibility, and Affordability

What sources of energy will be most available, affordable, and flexible in the future? Pessimistic hyperbole aside, hydrocarbons (coal, oil and natural gas) are an *expanding*, not depleting, resource.[14] The world's proved reserves of crude oil are fifteen times greater today than they were when such oil statistics began to be recorded over a half century ago. World natural gas reserves are five times greater than they were in the mid-1960s. Coal reserves are four times greater than originally estimated a half-century ago and twice as great as all of the known oil and gas reserves combined on an energy-equivalent basis.[15]

New members of the hydrocarbon family are being commercialised. In Venezuela, tar-like oil is being upgraded into a power plant feedstock called orimulsion.[16] Estimated reserves of this so-called

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[6] In August 2000, consumers in Britain went so far as to abstain from buying gasoline for several days in order to protest high prices. Gasoline prices in Britain are amongst the highest in the world – four times those in the US – as a result of punitive taxes.

[7] Even former US Vice-President Al Gore, who warned against cheap energy in his book *Earth in the Balance*, complained about high gasoline prices and vowed to not increase energy taxes during his campaign for the U.S. presidency in 2000 (Seelye, 2000, p. A2).

[8] John Holdren, "Memorandum to the President: The Energy-Climate Challenge," in Donald Kennedy and John Riggs, eds., *U.S. Policy and the Global Environment: Memos to the President* (Washington: The Aspen Institute, 2000), p. 21.

[9] Paul Ehrlich and Anne Ehrlich, *Betrayal of Science and Reason* (Washington: Island Press, 1996), p. 31.

[10] Siteur (1996). Exceptions include Malaysia, which obtains only about 15 per cent of its domestic energy from biomass, and Singapore.

[11] Home stoves tend to be poorly flued, leading to horrific respiratory problems.

[12] A great deal of time is spent gathering wood and creating dung pats that could otherwise be spent on more productive activities.

[13] This is especially true of dung, which is often handled by young children and contains all manner of bacteria and other disease-causing agents.

[14] Although some environmentalists claim that belief in imminent depletion is no longer held, studies and books continue to argue the opposite, often in a sustainability context. See Colin Campbell, *The Coming Oil Crisis* (Essex, England: Multi -Science Publishing Company, 1997); Kenneth Deffeyes, *Hubbert's Peak* (Princeton: Princeton University Press, 2001); and James McKenzie, "Oil as A Finite Resource: When is Global Production Likely to Peak?," World Resources Institute, March 1996.

[15] These statistics come from Robert Bradley, *Julian Simon and the Triumph of Energy Sustainability*, pp. 28-31.

[16] Orimulsion® is a registered trademark of Bitúmenes Orinoco, S.A (PDVSA-Bitor) and is licensed to Bitor America Corporation.

"fourth fossil fuel" are greater than the global supply of crude oil on an energy-equivalent basis. New technology is also commercializing the vast quantities of oil sands of Alberta, Canada. In addition, drilling and refining innovations are enabling us to tap previously inaccessible or uneconomic reserves in remote onshore and offshore areas—all outside of the Middle East.[17]

Technology is also increasing the *flexibility* of hydrocarbons. Processes now exist to convert stranded (unmarketable) natural gas reserves into gasoline and diesel for motor vehicles. While such resource substitution does not increase the aggregate supply of hydrocarbons, it does increase the amount that is economically recoverable. As the technology of hydrocarbon improvement and substitution develops, the *enhanced* hydrocarbon age may replace the hydrocarbon age as a new energy era later this century and even far beyond.

The hydrocarbon age is still young in physical terms. A working group of the Intergovernmental Panel on Climate Change (IPCC) calculated that total cumulative world consumption of hydrocarbons constituted only 1.4 percent of what is estimated to remain.

This abundance explains why energy economists have yet to see a "depletion signal" nearly two centuries into the mineral-fuel age. One possible explanation, proposed by Thomas Gold, is that super abundant hydrocarbons exist deep in the earth and are slowly seeping toward the drill bit.[18] A more conventional explanation is that the ultimate resources, human ingenuity and financial capital, are not depletable but expanding, and it is these resources that are driving the discovery of new reserves and new ways of extracting, processing, and consuming current reserves of hydrocarbons.[19]

The increasing abundance of hydrocarbons has led to increasing affordability, whether measured in terms of inflation-adjusted prices or work-time pricing (the amount of time it takes the average labourer to purchase a unit of energy). Today, the average labourer in the U.S. can purchase both a tank of gasoline and several days of residential electricity in about three hours of work time. In 1940, the same purchase of 15 gallons of gasoline and 100 kilowatt-hours of electricity required ten-hours of labour. But consumers have reason to desire still lower prices for the record quantities of energy they are now purchasing.[20]

Environmental Quality

Much opposition to the modern hydrocarbon-based economy is driven by a belief that the extraction, processing, distribution and consumption of hydrocarbons are environmentally damaging. This opposition has focussed on damage to air quality in particular, but hydrocarbons have other environmental impacts including effects on agriculture and forestry.

Air Quality

For centuries, the burning of wood and coal made cities across the world unpleasant places to live. Over the course of the past half-century, however, most major cities in developed countries have seen declining levels of air pollution.[21] This is especially true of cities where the major pollutants were smoke and sulphur dioxide. London now has lower levels of air pollution than at any time since the 16th century.[22] Factories and power stations have either moved out of the cities or switched to less polluting production processes. Domestic users have switched from wood and coal to natural gas and electricity as the primary sources of heat. This is not to say that air pollution from the burning of hydrocarbons has been eliminated, nor that it cannot be improved; low-level ozone and to a lesser extent carbon monoxide and soot (mostly from older diesel vehicles) remain problems in many cities.

[17] Herrick et al. (2002).
[18] For a critical review that still finds Gold's hypothesis plausible, see Ehrlich (2001), chapter 7.
[19] These statistics come from Robert Bradley, *Julian Simon and the Triumph of Energy Sustainability*, pp. 28-31.
[20] Ibid., pp. 47-53.
[21] See e.g. Hayward and Jones (1999); Goklany (1999a); Lomborg (2001), pp. 163-177.
[22] Lomborg (2001), p. 165, figure 86.

But the environmental impact of hydrocarbon consumption in developed countries is declining even while its use is increasing.

In developing countries, the story is somewhat different. There, urban air pollution is in many cases becoming worse. Industrialisation tends to result in an increase in pollution in the short-term, followed by a reduction in pollution once a certain level of development is achieved – at average incomes of about $5,000 (1985 U.S. dollars).[23,24] But even this is misleading because it is based on measures of 'pollution' that apply in developed countries. Circumstances in developing countries are very different. The worst air pollution in the world results from burning dung, wood, and coal in poorly flued domestic fires.[25] People in poor countries are often able to adopt less polluting technologies (such as more efficient stoves) at very low income levels.[26] In this respect, it could be argued that environmental quality improves more or less linearly with improvements in income. However, the switch to more efficient wood stoves is only one step along the road to high-quality, low-pollution energy – and one that is hampered by certain cultural factors.[27] In this context, grid electricity, even from the dirtiest source–uncontrolled coal-fired plants–would probably be an environmental improvement for the 1.6 billion people currently denied this luxury.

Agriculture

Energy, and in particular hydrocarbon-derived energy, has contributed to agricultural intensification in many countries, enabling the production of chemical fertilisers and synthetic pesticides, as well as the mechanisation of agricultural processes (preparing, planting and harvesting crops; milking cattle; battery farming of chickens and pigs). In addition, it has enabled longer-term food storage (through large-scale processing, packaging, and refrigeration), as well as the economical transportation of foods over long distances.[28]

The positive results from reliance on hydrocarbons include significant increases in yields (more than doubling for many cereal crops over the past century) and reductions in waste (as a result of better storage and transportation). Thus, more people are now fed using less land than would have been required without the use of hydrocarbon-derived energy. Despite the fact that the amount of cropland per capita has been almost halved, daily food supplies per capita (in Kcal/capita/day) have increased 23% from 1961 to 1997, and the real price of food commodities has declined 75% since 1950.[29] Thus, notwithstanding a 40% increase in population between the early 1970s and mid 1990s, the number of chronically malnourished people in developing countries dropped from 920 million to less than 800 million (or from 35% to 19% of their population).[30]

The negative results have included: eutrophication of some streams and rivers as a result of excessive use of nitrogen fertilisers; reductions in some farmland species, including certain bird species; and land degradation (soil erosion, salinisation) in some poorly managed and sensitive areas. However, these negative consequences have been magnified by government subsidies (either for production or irrigation) and/or inappropriate systems of ownership[31] and are thus not directly attributable to energy use per se.

[23] Grossman and Krueger, 1993; Shafik and Bandyopadhyay, 1992.
[24] As one might expect, this effect is more marked for urban air quality than aggregate emissions – reflecting the difference in impacts of emissions according to where they take place (Selden and Song, 1994).
[25] Goklany (1995).
[26] Nathan (1996).
[27] In many part of the developing world, women are excluded from engaging in formal employment, so their time is undervalued. As a result, they are willing to spend more time than they might otherwise choose gathering fuel wood, which means that they are less concerned about the efficiency with which the wood burns. (Nathan, 1996).
[28] Scarlett (1999).
[29] (Goklany 1999b).
[30] FAO (1997, 1999).
[31] In particular, restrictions on private ownership have undermined incentives to manage land sustainably. Morris (1995); Martin (2000).

Notwithstanding the excessive conversion of land in Europe, the U.S., and elsewhere as a result of subsidies, the loss of farmland species must be balanced against the likely larger benefits of reduced conversion of wetland and forest that would have occurred had not fossil fuel use increased agricultural productivity.[32] High levels of shifting ('slash and burn') agriculture have a far more serious impact on biodiversity than more efficient sedentary agriculture.[33]

Had it not been for technological progress in the food and agricultural sector, feeding the world's population at 1961 productivity levels would have required an additional 1,040 million hectares (Mha) of cropland beyond the 1,510 Mha of cropland actually used in 1997.[34] Such progress also helped reverse centuries of deforestation in the richer nations.[35] Between 1980 and 1995, for instance, forest cover increased by about 20 Mha in the developed countries.[36]

Forestry, Fuel-wood and Biomass Energy Generation

As with agriculture, forestry has benefited from hydrocarbons and hydrocarbon energy in the form of fertiliser, pesticide, harvesting technologies, transport and processing. The result has been a significant increase in forestry yields and a partial shift in production from Northern Europe and Canada to South America and South East Asia, where costs of production are lower because the climate is better suited to rapid plant growth.

While the conversion of natural forest to plantation forest has in many cases had a negative impact on species diversity, the intensive forestry that is made possible by hydrocarbon-based energy reduces pressure on non-plantation forests by supplying higher levels of wood and wood fibre at lower cost.[37] If the same amount of wood were to be produced less intensively, the impact on biodiversity would be far more extreme.

As countries develop, the use of wood and dung for fuel tends to decline relative to coal, oil, gas and electricity (which is mostly produced using hydrocarbons, nuclear, or hydro), with significant environmental advantages in terms of reduced exposure to the toxic by-products of poorly flued wood and dung fires.[38] Despite the serious environmental consequences of the production and burning of biomass, there has recently been a surge in support for the use of wood and other organic material to generate energy because of its putative benefits in terms of reduced climate change impact.

The impact of such wood/biomass systems on biodiversity is a contentious issue. To produce energy from biomass requires the expenditure of significant amounts of energy in order to produce and apply fertiliser; prepare the soil; and plant, water, harvest, and transport the crops.[39] The ecological effects of biomass energy production vary widely depending upon the ecosystem being displaced. If perennial biomass production displaces existing farming operations, such production may be ecologically beneficial.[40] However, given the likely increase in global demand for food crops, as populations and wealth increase, this seems a very unlikely outcome. The more probable alternative is that biomass crop production would displace previously undisturbed forests, wetlands, and plains.[41]

Climate Change

In spite of – or perhaps because of – improvements in the overall environmental profile of hydrocarbon energy, some critics have begun to focus on the threat of climate change from hydrocarbon-related greenhouse gas (GHG) emissions as a justification for severely regulating the use of hydrocarbons beyond traditional pollution control.

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[32] Goklany (1998, 1999c).
[33] Southgate (1998); Wilcove et al. (1998).
[34] Goklany (1999b).
[35] Goklany and Sprague (1992).
[36] FAO (1997).
[37] IIED (1996); Southgate (1998); Moore (2000).
[38] Goklany (1995).
[39] Perlack et al. (1992); Lorenz and Morris (1995).
[40] Cook and Bayea (no date).
[41] Bayea et al. (1992); Miles and Miles (1992); OTA (1993); Tolbert and Downing (1995); Tolbert and Schiller (1996).

There is insufficient space in this chapter to address the scientific concerns relating to global warming. However, many consequences of climate change are *not* expected to be harmful. Indeed, leading economists analysing its impact note that there are likely to be many ecological and social benefits of a moderately warmer and wetter world, not to mention the benefits of longer growing seasons and a fertilisation effect of higher carbon dioxide (CO_2) concentrations on plants and agriculture.[42] Economists also factor in the scientific evidence that weather extremes are not increasing,[43] the rate of growth of GHGs has slowed,[44] and the greenhouse warming is favourably distributed toward higher minimum temperatures (a reduced diurnal cycle).[45] A disproportionate amount of the warming is also "dead warming" where higher below-freezing temperatures are recorded. Greenhouse physics, as well as the statistical record, point toward man-made warming occurring in the coldest and driest air masses, predominantly during winter Siberian and Alaskan nights.[46]

While warmer and wetter are trends in the positive direction, sea level rise from the human influence on climate is not. Yet even this concern has moderated. The Intergovernmental Panel on Climate Change (IPCC) reduced its estimate of sea level rise from the human influence on climate as new information became available. The sea level rise forecast made in the IPCC's 1990 report was reduced by 25 percent in 1995, and by a further 2 percent in their 2001 report.[47] Some evidence suggests that the sea level rise of the 20th century has been greater than in the 19th century, although "no significant acceleration in the rate of sea level rise during the 20th century has been detected."[48]

The global warming scare has led two European-based oil majors, BP and Royal Dutch Shell, to trumpet their diversification into renewable energy in general and solar in particular. Meanwhile, the two companies' aggressive hunt for oil around the world and investments in cleaner gasoline are making the petroleum age more sustainable, not less. BP, having reconsidered its "Beyond Petroleum" moniker, is poised to help develop the Arctic National Wildlife Reserve.[49] Shell has offered an alternative scenario where the market share of renewable energies catches up to hydrocarbons and nuclear by mid-century, but reality suggests otherwise. Shell's own highly publicized multi-year global budget for renewable energy—$500 million thus far (2002), and a further $500million to $1billion by the year 2007—is a fraction of their budget for developing oil and gas fields in the Gulf of Mexico alone.[50]

Security Enhancement

Supply security is another dimension of energy sustainability. Oil import security became a major issue in the world's largest economies as a result of the supply shocks of 1973 and 1979, caused by the intergovernmental oil cartel, OPEC, which choked supply in order to increase state revenue. Almost three decades later, environmentalists cite dependence on Middle Eastern oil as a second reason (after climate change) to move beyond the petroleum era.[51]

However, the worst effects of first oil 'crisis' in 1973 were caused not by OPEC but by price and allocation regulation by the U.S. government. Shortages have not reappeared in the decades since because retail prices have been free to rise to limit demand in response to diminished supply.

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[42] Bradley (2000), pp. 91-95, 104-12.
[43] IPCC (2001), pp. 5, 15-16, 33-34, and 104.
[44] Ibid., p. 7; Hansen (1998).
[45] IPCC (2001), pp. 2, 4, 27, 30, 101, 104, 106, 108, and 129.
[46] Ibid., pp. 13, 67, and 116-17.
[47] Ibid., p. 16; IPCC (1996), p. 6.
[48] IPCC (2001), p. 699.
[49] Jenkins (2001).
[50] Taylor and VanDoren (2002), p. 3. Shell has also tried to introduce social factors to supplement traditional profitability measures to better stack up against the "super-majors." Williams (2000).
[51] See, for example, Joseph Romm and Charles Curtis, "Mideast Oil Forever?," *Atlantic Monthly*, April 1996, pp. 57-74; John Holdren, "Energy: Asking the Wrong Question," *Scientific American*, January 2002, pp. 65-66.

The amount of oil that a country imports is not an indicator of its "energy security." Petroleum prices are set in a globally interconnected market by worldwide supply relative to demand. A supply cutback or oil embargo anywhere affects countries that supply all of their own oil (Britain), none of their oil (Japan), or half their oil (the United States). Government programs to reduce consumption (such as Britain's sizeable gasoline tax) or to stockpile supply (such as the Strategic Petroleum Reserve in the U.S.) are costly taxpayer responses to the "improve" security.

The market offers self-help alternatives for energy users who face supply and price risks. In the 1970s and 1980s, futures markets were established for crude oil and oil products, where prices and supply could be locked in for months or even years. Natural gas followed in the 1980s and electricity products in the 1990s. Internet trading of energy commodities has increased transparency and improved opportunities for price and supply hedging. Mandating fuel diversity for its own sake or stockpiling oil are not necessary. Market demand and competition will continue to drive improvements in the future.

Energy Hyperbole

Alarmism has presaged the call for a new energy future of renewables, hydrogen-based fuel cells, electric vehicles, and distributed generation. Should we take this call seriously?

Environmentalists who advocate "renewable energy" in general actually *oppose* many specific projects.[52] They have turned against the kingpin of renewable energy, hydropower, because of concerns about fish migration and loss of habitat. They have blocked wind and geothermal projects in sensitive areas. Some have questioned the viability of solar farms and biomass projects on the grounds that these are too land intensive for the (limited) energy that they produce. Their concern about the role of CO_2 emissions on global climate fails to square with the fact that virtually carbon-free hydropower and nuclear power, which they also oppose vehemently, produced 240 times more power globally than grid wind and solar combined.[53] The reality is that we are moving away from the "renewable" energy era of wood, waste, water, solar, and wind. More intensive, portable, and reliable energy carriers—coal, oil, and natural gas—have replaced those energy sources in developed countries and are poised to do the same in developing countries.

Will fuel cells and electric cars—technologies that have received a great deal of attention in recent years—be commercially viable in the decades ahead? The fuel cell was invented in 1839, and subsequent attempts to commercialise it have repeatedly failed. While possible future breakthroughs in fuel cell technology cannot be dismissed, it would take a courageous venture capitalist to bet on a technology with such a dismal past. The electric car, on the other hand, dominated American transportation until Henry Ford's internal combustion engine entered mass production after the turn of the last century. It seems unlikely that electric cars will replace the gasoline-powered automobiles in our lifetime, and even if they did, such vehicles will probably still rely on hydrocarbon-based electricity.

What about "distributed energy?" Again, the past is being sold to us as the future. In most developed countries, isolated plants housed in the buildings they electrified were displaced in the mid-20th Century by large central station plants that economically served whole business and residential districts. Reduced waste and more reliable service brought an end to the "distributed generation" era.[54] Mini-generators are still common in houses and apartments in developing countries, but only because of the failure of governments in those countries to allow private companies to supply high-quality grid electricity to consumers.

One only need compare two Indian cities: Bombay and Delhi. Bombay receives its power from a private company, which was set up before the government got into the electricity supply business. Power-outages are rare, and few people have any need for backup generation. Delhi, by contrast,

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[52] Bradley (1997), pp. 15-22; 26-36.
[53] USEIA (1999), pp. 38-39; e-mail communication from Patricia Smith, Energy Information Administration, March 1, 2002.
[54] Bradley and Fulmer (forthcoming).

receives its electricity from a government-run company and power outages are common. This is especially true during the long hot (40°C or more) summer months when demand for air conditioning rises dramatically. As a consequence, Delhi's wealthier citizens typically have diesel-powered generators that provide back up energy and contribute to the city's unpleasant smog.[55]

Problems and Improvement

Real energy problems stem primarily from acts of government, not acts of the market or God. The electricity shortages that California experienced between May 2000 and June 2001 had the same cause as gasoline lines during World War I, World War II and the 1970s in the United States—retail price controls. Regional gasoline price spikes experienced in the United States in the summer of 2001 were caused by clean air requirements that required different areas to use different blends of motor fuel ("boutique" fuels).[56]

Not all energy problems are caused by "government failure," but the most pronounced aberrations generally are. Since most energies are commodities, they will be periodically subject to price swings. Often these swings favour consumers—unregulated energy markets are generally buyers' markets. But at times supply constraints can increase prices above historical or customary levels. Market processes then come into play to bring prices back to normal levels—except when tax policies (such as in Europe for motor fuel) make prices permanently high. In free markets, the cure for high prices is high prices.

Poverty—The *Real* Energy Sustainability Issue

The threat to continued energy progress–or energy sustainability–is not depletion, pollution, or anthropogenic global cooling or warming. Activist government policies that *increase prices* and/or *reduce reliability* are the real threat for those still awaiting modern energy and to those who are more reliant on energy than ever before.

The major challenge for energy sustainability in the new century is *eradicating energy poverty*. The World Energy Council estimates that 1.6 billion people—one fourth of the global population—still do not have access to electricity and other modern forms of energy.[57] These individuals consequently suffer from acute smoke inhalation, subsistence productivity, and unsanitary living conditions. A study by the United Nations and the World Energy Council estimated that two million premature deaths per year occur from primitive biomass pollution alone.[58]

Regional energy poverty amid global plenty is the direct result of economic statism whereby a paucity of private property rights, hampered market exchange, and poor legal institutions have stymied human ingenuity and progress.[59] In such settings, people can often be the problem rather than the solution. This is far different than in market settings where the statistics show that the hypothetical average person is simultaneously increasing energy and reducing pollution.

Damages from climate change are particularly acute for the most vulnerable regions of the world that have the least ability to cope with weather extremes or adapt to new climatic circumstances over the longer term. Poverty magnifies the damage caused by extreme weather events (events that have not been linked to the human influence on climate).

Thus poverty, not weather/climate events themselves, is the primary sustainability issue, and poverty eradication is the major policy imperative. If climate change policies divert resources that otherwise could be used to improve living standards—say introduce clean water and electricity—economic and thus environmental sustainability may worsen in the short run.[60] The policy implication is clear.

[55] Julian Morris, personal communication, 3-June 2002. See also: "Hither and Thither: Trends in Asian Power" BusinessWorld (Philippines), 6 August 1999.
[56] Lieberman (2001).
[57] World Energy Council (2000), p. 5.
[58] UNDP, UNDESA, and WEC (2000), p. 15.
[59] See de Soto (2000) and Yeatts (1997).
[60] Lomborg (2001), pp. 305-24, 348-52. See also Goklany (2000), pp. 189-213.

According to Sarewitz and Pielke, "The moral imperative should be not to prevent human disruption of the environment but to ameliorate the social and political conditions that lead people to behave in environmentally disruptive ways."[61]

The same may be true if climate change policies reduce energy availability or affordability for populations that are industrializing. Another potential threat to living standards is international trade restrictions (such as sanctions) that pose as enforcement mechanisms for global climate-change regulations.[62] Any of these policies could halt "no regrets" GHG reduction initiatives that wealthy nations are following to a large extent.

Climate change policies for the developing world should be designed to pass a short-run poverty sustainability test. Will the policies make energy expansion less likely? Will such policies make energy more expensive or less reliable? And finally, will the policy hinder the most critical task of moving statist economies toward sustainability via the institutions of private property, voluntary exchange, and the rule of law?

Policy proposals should be also judged under a health-is-wealth standard in both developed and undeveloped countries alike. Regulatory programs intended to promote health through the perceived mitigation of man-made climate change, must overcome a health loss that intrinsically occurs when private sector wealth is lost through taxation or regulatory burdens.[63] This "opportunity cost" part of the cost/benefit equation is another barrier between moving directly from a scientific finding of a human impact on climate to an activist public policy intended to mitigate climate change.

Conclusion

Across-the-board improvements in hydrocarbon energies, coupled with environmental and economic problems with the leading alternatives to hydrocarbons, are expected to increase the combined market share of oil, gas, orimulsion, and coal in the next decades. The International Energy Agency predicts that fossil fuels will account for 90 percent of the world's primary energy mix by 2020, up slightly from their share recorded in 1997.[64] The U.S. Energy Information Administration also predicts that the market share hydrocarbons will rise relative to renewables and nuclear in the next 20 years.[65] In the longer term, the future of the hydrocarbon era looks bright as new forms of hydrocarbons commercially vie with each other to best meet people's needs.

Energy policy is becoming more focused on expanding energy reserves and infrastructure to keep up with demand growth. Gone is the assumption that supply will always be there, despite a variety of government disincentives, until politically favoured energy alternatives can emerge. Environmentalist critics of hydrocarbons have retreated to the position that affordable, available energy is prerequisite to policy reform.

The mantra of reduced overall energy usage has become less politically and intellectually tenable over time. Hydrocarbon energies are at the center of today's consumer-driven technology revolution. More importantly, an estimated 1.6 billion people still do not have access to electricity and other modern forms of energy, leaving them impoverished and physically at risk.[66] This mass of humanity would benefit economically and environmentally from grid electricity. Expensive, intermittent distributed generation from solar power may be necessary for remote locations receiving electricity for the first time, but this is likely to be no more than a bridge to conventional power generation. Wealthy societies may be able to afford public sector forays to support exotic energy technologies, but consumers around the world desire plentiful and affordable energy to improve their lives.

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[61] Sarewitz and Pielke (2000), p. 63.
[62] See, generally, Brack et al. (2000). On the clash between national sovereignty and the Kyoto Protocol, see Rabkin (1998), chapter 7. For the inherent problems of Kyoto's proposed international carbon trading scheme, see Victor (2001).
[63] See Graham and Wiener (1995) and Hahn (1996).
[64] International Energy Agency (2000), p. 21.
[65] USEIA (2001), p. 176., Table A2.
[66] WEC (2000), pp. 5, 66.

The good news is that hydrocarbons are plentiful and their use is growing cleaner and more "sustainable" over time. The bad news is that the obsession with renewables and energy efficiency to meet growing demand[67] over the past 25 years has diverted sizeable resources away from more productive uses. In order to move towards a more sustainable energy future, it is of critical importance that governments around the world get out of the energy business and leave it to self-interested market participants. The new *sustainability agenda* should be to privatise indigenous resources and energy infrastructure, uphold property rights and the rule of law, and otherwise leave the provision of energy to the market.

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