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## SUSTAINABILITY, ENERGY TECHNOLOGIES, AND ETHICS

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### ABSTRACT

A study of the economic, social-political, and environmental consequences of using renewable energy technologies (RETs, e.g., photovoltaics, wind, solar thermal, biofuels) as compared to those of conventional energy technologies (CETs, e.g., oil, coal, gas) would show that RETs are singularly consistent with a whole ethic that is implicit in the concept of sustainability. This paper argues for sustainability as an ethical, as well as a pragmatic, imperative and for RETs as an integral part of this imperative. It brings to the fore some of the specific current economic, political, and environmental assumptions and practices that are inconsistent with both sustainability and with a rapid deployment of RETs. Reflecting an emerging planetary awareness and a pressing need to come to terms with intra- and intergenerational equity, the concept of sustainability explicitly entails the right of future generations to the same opportunity of access to a healthy ecological future and the finite endowment of the Earth's resources as that of the present generation.

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### KEYWORDS

Conventional energy technologies, energy and environment, energy ethics, energy politics, energy economics, future and energy, intergenerational equity, renewable energy technologies, sustainability

### INTRODUCTION, TERMINOLOGY, AND SCOPE

The term “sustainable development” can have a variety of meanings. Following the Brundtland Report (1987), we use sustainable development to mean development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Granting the need for more specific sustainability criteria and indicators as appropriate to specific circumstances, we propose that the concept of sustainability itself not only can, but should, be used to guide local, national, and planetary choices by viewing them in the context of their long-term consequences. Co-emergent with an increasing awareness of global interdependence between the human economy and Earth's ecology, the haves and have-nots, and short-term choices versus long-term consequences, is the concept of sustainability, which has now become both an inherently ethical and a pragmatic paradigm to use in evaluating energy choices. In what follows, we (1) examine some of the more significant economic, political, and environmental assumptions and practices of today that militate against a rapid deployment of RETs in the near term, (2) contrast them with those based on an ethic of sustainability, and (3) assess the feasibility of a rapid deployment of RETs.

We accept that energy conservation and energy efficiency technologies are generally more consistent with sustainability than are many kinds of energy production options, hence we only review the major alternative energy supply options. In general, we use technology (particularly in CETs and RETs) to include the whole life cycle of that technology: that is, all the processes from initial exploration, research and development phases, through the economic life of the conversion process, to the disposal of the conversion plant and any remaining wastes.

### ENERGY AND ECONOMICS

Currently, choices among energy supply options are made almost exclusively using models of economic efficiency in a competitive market (i.e., economic rationality as exemplified by cost/benefit analysis). Those options that maximize net present benefit or value are ranked highest. Consequently, only that which is commensurable with a value for the near term and can

be expressed in monetary terms is accounted for. This has the profound effect of largely precluding qualitative dimensions of value. Yet, we maintain that it is exactly these nonquantifiables that ultimately matter most (e.g., peace, freedom, spiritual and cultural values, and aesthetics). In special cases, some nonquantifiable and noneconomic aspects are currently treated as "externalities". For example, polluting the environment is accounted for only when there are laws, fines, or consumer resistance affecting the monetary bottom line of the institution doing the analysis. All other values are excluded, thereby assigning them a value of zero.

Further, our present economic model has proven itself particularly inadequate in dealing with questions about an equitable distribution of resources in time (i.e., intragenerationally). Because economic energy choices are invariably based on the present value of a prospective choice, even the short list of the future costs and benefits that are quantifiable is formally discounted. While discounting is a fundamental assumption to the workings of the neoclassical economic model, it is diametrically opposed to the idea of sustainability, because it favors the present. More specifically, it has the effect of militating against RETs and favoring CETs because the major component of the cost of RET-based energy is in the initial construction cost, which shows in the analysis in full. In contrast, a major cost component of CET-based energy is in future fuel costs incurred throughout the life of the plant, and those costs are discounted over the life of the plant, and therefore would show as a relatively minor cost in any present-value analysis.

Finally, there is the very important question as to whether the full cost of fossil fuels—specifically the full replacement cost—is accounted for in the current pricing of CETs, as well as to what that full cost might be. To illustrate this point, we quote Rene Ortiz, then Secretary General of OPEC (Ortiz, 1980), where he presented the following economic rationale for the future pricing of crude oil: "[Oil] Consumers must accept the principle of an equitable and remunerative price level, which is stable in real terms, so as to provide the producing countries with a logical justification for the continued depletion of their finite resources. This implies not only maintaining the real value of the barrel exported through compensation for the erosion of its purchasing power due to inflation or currency variations, but toward parity with the marginal cost of alternative sources of energy, or the real replacement cost. Such a smooth transition from today's still low energy prices to more realistic long-term ones would permit investors to make their commitments, both to energy production and to energy savings, with renewed confidence."

What would a smooth increase of oil prices, in real terms and over an appropriate time frame toward parity with the marginal cost of alternative sources of energy—or the real replacement cost—of crude oil be? Would that cost not be, ultimately, the cost of energy from RETs? How else could one "replace" the energy of extracted oil? And if it is, would that cost not be just the marginal cost that will make RETs competitive? It seems clear that in this short statement Mr. Ortiz was both indicating that the then current price of crude oil, as well as all energy, was too low (especially to account for the full replacement costs) and was also outlining the rationale and process for a gradual increase in the price OPEC will charge for exported crude oil.

It is important to note here that first, Mr. Ortiz accurately perceived that crude oil prices did not reflect the full replacement cost of that nonrenewable resource, and that second, now, some 18 years later, the price of OPEC oil, and consequently all oil, did not rise to the levels he envisioned. The same remains true of all other nonrenewable energy resources today: their price does not include the full replacement cost (in very few situations, a very low severance tax or depletion allowance, not nearly a full replacement cost, is added). As a consequence, current CET energy prices are low and promote higher consumption rates than would exist if the full replacement costs were included. The low cost of nonrenewables remains the major reason why RETs appear less competitive than CETs. This clearly skews the economic analysis in favor of the CETs and against the future. In intergenerational equity terms, our present use of nonrenewables without paying in full for their replacement cost is using the future to subsidize the present. This practice is clearly, brazenly, inconsistent with the requirements of sustainability.

The perverse effects of not including the full replacement cost on the workings of a competitive market system are worth noting briefly. The oil producer gains by keeping the price of oil low enough to promote its continued, high-volume use, and to compete effectively both within the oil market and against other resources. Once his production costs (specifically exploration, development, and extraction) are covered by the price he charges, he has no incentive to include the additional, full replacement cost. Unlike, for example, a bookseller, it is not the oil producer's practice to replace what he extracts, and sells, from the Earth's store. As one oil field is depleted, he simply finds and develops another. As the competitive market works its paradigm, no other producer could remain competitive if he were to include the full replacement cost of his oil. And so it seems ironic that oil and other extracted, nonrenewable resources, while traded mostly in competitive markets, are nonetheless traded at a low, expedient price that is ultimately subsidized by the future. We benefit, but the future—having no voice in this—pays.

Some argue that we simply cannot anticipate the needs of future generations, and that our endowment to them will probably include capital stock and technological innovations that will serve to offset the value of Earth's depleted resources. We ask: Would you want to be the victim of this logic? And finally, how exactly do we "replace" billions of tons of coal or barrels of oil or cubic feet of natural gas in their usefulness for applications other than combustion? Once gone, they are gone.

In contrast to the economic rationality paradigm, where all of life is essentially reduced to present economic monetary value, is the community paradigm, which would offer members of the local village all the way to the global village the same opportunities, both now and into the future. Where CETs involve corporate or government-scale ownership, RETs are suitable to local ownership, using locally available resources and tailorable to local needs. Where CET applications are predicated on economies of scale where bigger is better, RETs are predicated on modularity, and can be added incrementally and on a pay-as-you-go basis. With RETs, economics becomes a tool of the human agenda, rather than the reverse; and technology is subservient to human values, rather than the reverse. Ours then becomes a preserving society, rather than a consuming society. *The community paradigm is about taking what we need, rather than what we want. It is an economics of a true democracy where all people, and the biosphere in general, take precedence over the advantage of the few—both now and into the future.*

### ENERGY AND POLITICS

In any discussion of energy and politics, it seems necessary to single out crude oil for its inordinate relevance. The impact of this energy resource on world peace and stability is difficult to overestimate. Its unique status derives from two main factors, namely: the West's extreme dependence on crude oil products to fuel its economies, and the concentration of oil resources and production in the remote region of the Gulf States. On a number of occasions the continued supply of crude oil has been declared a "vital interest" of the U.S. As recently as 1991, upholding this vital interest resulted in war with Iraq. In what follows, we will examine the factors that influenced both oil production and the price of crude oil in the international market in recent history. Were these the economic factors of supply and demand, as our competitive market models would suggest?

The level of crude oil production in the Gulf States has inordinate and pervasive consequences. It is the single most influential factor in the international oil marketplace, and a determining factor of the price of internationally traded crude oil. As such, this price also sets the benchmark for the price of all other forms of energy. In 1996, Saudi Arabia alone produced more oil than the entire U.S. In the same year, the Gulf States produced a full 29% of the world's total oil production (EIA, 1998).

The level of crude oil production in the Gulf States has been predetermined to a large degree by political, rather than resource-economics, or competitive market factors. There is rather convincing evidence that crude oil production has been kept artificially high to force the price of oil to remain relatively stable, and low. The case has been made that crude oil production levels had much more to do with the geopolitics of the U.S./U.S.S.R. conflict than with economics (Schweizer, 1994). As a consequence, international crude oil prices have been surprisingly low and world oil consumption and production continue to rise, from 61 MMBPD in 1987 to 70 MMBPD in 1996—an increase of 15% in just one decade (EIA, 1998). How long can this high production and low price trend be sustained? And is it any wonder that RETs, under these circumstances, appear noncompetitive? They do not stand a chance—not because they are not competitive, but because the price of nonrenewable energy resources is held low.

Energy availability will undoubtedly continue to be a major factor, and a potential source of conflict for some time to come, reflecting the discrepancy between centers of demand and centers of nonrenewable energy supply. In this state of affairs, long-term, inter- and intragenerational equity strikes us as neither utopian nor altruistic, but rather as a minimum requirement for a peaceful, long-term existence and a prerequisite for anything resembling global stability and security. The politics, economics, and ethics of self-service are divisive and are becoming increasingly unworkable as organizing principles in an interdependent world. Our historically based worldviews, paradigms, and institutions have not yet caught up with these realities (e.g., the UN, World Bank, WTO, and, as importantly, institutes of learning and research, where much work remains in developing the concept of sustainability and its applications).

That a healthy planetary economy and infrastructure depend on a sustainable relationship with the planetary resource base and ecology is both axiomatic and practical. RETs tend to promote democratization, self-reliance, and individual and community empowerment at many levels through their modularity and relationship to the local ecology. In contrast, CETs are sooner consistent with centralized power and large control infrastructures, dependency, and, in many developing countries, large foreign capital investments—each of which causes a distortion of local, sustainable, long-term interests while bringing poverty and despair to the disenfranchised.

### ENERGY AND THE ENVIRONMENT

*The difference in the effects of CETs and RETs on the environment is dramatic and largely self-evident. The atmospheric emissions of the products of combustion processes from CETs used for both electric power generation and transportation have significant detrimental health, environmental, and ecological impacts. The more we learn, the more the uncertainties diminish, and the more alarming the true impacts become. They show up primarily as toxic atmospheric air in the biosphere, acid rain, and global climate change. The U.S. Department of Energy (1998) gives the following assessment on global climate change: "Perhaps no single environmental issue is as complex or holds such potentially profound implications for the world's*

inhabitants than the issue of global climate change. There is little question that human activity is changing the makeup of the atmosphere that surrounds our planet. ... In 1995, a panel of more than 2,000 of the world's top climate scientists concluded that the Earth was indeed warming and that the "balance of evidence suggests a discernible human influence" on climate. ... [That] the bulk of recent evidence—from rising sea levels and retreating glaciers to freak storms and floods—appears to be falling within the boundaries of scientists' predictions of greenhouse warming."

Toxic air, acid rain, and particularly climate change, are transnational and planetary. In contrast, one of the primary motives for deploying RETs remains their local and relatively low ecological and human health impact. Beyond these obvious practical benefits, an energy path that minimizes pollution and our impingement on the environment constitutes an entire ethic in and of itself. Where CETs exploit the planetary resource base and ecology, RETs bind us to the planet. The one has resulted in alienation, the other holds the promise of co-evolution.

### ENERGY AND ETHICS

Any technology is necessarily embedded in a particular matrix of values and, thereby, is ultimately consistent with a certain ethic, or set of ethics. CETs are embedded in a matrix of values that are increasingly in conflict with a sustainable planetary future. With globalization, the scope of our concerns is appropriately changing and becoming more inclusive. The relationship of energy and ethics can be summarized in three categories. First, and high on the list of concerns, is the issue of present equity, where a peculiar geographical distribution of nonrenewable energy resources leaves hundreds of millions of people in chronic poverty, yet gives the relative few a tremendous abundance and riches. Second is the issue of intergenerational equity. It is manifestly unethical for us to squander the finite nonrenewable-resource endowment of the planet in a one-time use, without any real accountability to the biosphere in the present, let alone in the future. The third issue is ecological degradation and the expedient use of the environment as a dumping ground for discarded human wastes.

From the perspective of ethics and sustainability, CETs seem more and more to be anachronistic remnants of outdated, obsolete, and unworkable worldviews. Based on a myopic perspective and buttressed by institutionalized economic and political practices of times past, CETs stand in stark contrast to the longer-term ethical, inclusive, and ecological view supported by RETs. Comparing the two, we see two very divergent paths to two very different futures, one being stable and ethically defensible, while the other, in the end, is not. While CETs provide only for our material needs, and then only for a very short time, RETs meet our material needs and enrich our relational, ethical/cultural, and spiritual lives as well.

Hence the real question is not if we should—but how and when we should—change from CETs to RETs in time to avert even more suffering and further disasters. With Oliver Wendell Holmes, Sr., we note "The great thing in this world is not where we stand, but in what direction we are moving." Increasingly, trends toward a sustainable energy future existence are evident on a planetary scale, most recently in the December 1997 Kyoto convention on climate change, as well as on many other scales. In part reflecting these trends, a study by one of the most sophisticated, internationally reputable corporate planning groups, the Group Planning Unit of the Royal Dutch Shell Oil company (Shell, 1996), confirmed that profound change in the makeup of the global energy system is plausible in the relatively short term. In this study, the authors developed a "Sustained Growth" scenario in which fossil fuels dominate energy markets in the short run but renewable energy technologies "steadily progress along their learning curves, first capturing niche markets and by 2020 become fully competitive with conventional energy sources."

In the final analysis, only RETs are consistent with an economic, political, and environmental philosophy, underwritten by an ethic and a worldview that is both materially and spiritually sustainable—one that is necessary to take us into the future with our humanity intact. The concept of sustainability represents such an ethic and the early deployment of RETs is certainly a structural component of that ethic. It has become increasingly evident that the smart thing to do, and the right thing to do, are one and the same. This is the moral, as well as the practical imperative of our time. We ask: Do we dare avert our eyes, silence our conscience, and ignore it?

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