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Energy Efficiency
No Silver Bullet for Global Warming

by Jerry Taylor

Executive Summary

Undeterred by the Senate's refusal to ratify the mandatory reductions of greenhouse gases stipulated under the 1997 Kyoto Protocol, the federal government has plunged ahead with a $1 billion annual program to reduce industrial emissions that may contribute to global warming. The Climate Change Technology Initiative—administered by five separate cabinet departments—employs an amalgam of tax credits, research and development funds, product labeling and public awareness programs, demonstration projects, industry subsidies, and regulatory programs to increase energy efficiency and the economic attractiveness of renewable energy.

The program, however, is little more than a sham. The CCTI is but a repackaging of failed programs that have littered the federal budget for 20 or more years. The program offers misleading and incomplete cost/benefit analyses, is obsessed with remedying market failures that do not in fact exist, projects emission reductions that are wildly implausible, asserts a correlation between energy efficiency and energy consumption that is demonstrably false, proposes counterproductive labeling and product standards, and misleads the public about the ability of such a program—even if it performs as advertised—to measurably affect global temperatures.

The CCTI is built on economic ignorance and political symbolism. Regardless of one's position on the threat of global climate change, the CCTI is nothing but an empty and expensive political gesture.

Jerry Taylor is director of natural resource studies at the Cato Institute.

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Introduction

The Climate Change Technology Initiative is the major current administration proposal to combat global warming.[1] Most of the programs within the CCTI are not new. They have been a part of the federal budget for years but are now being justified on the grounds that they can reduce greenhouse gas emissions and avert changes in global climate.

Tax incentives, in the form of tax credits, are a major element (and also the major attraction) of the CCTI. Table 1 details the program's tax credits and their costs in lost government revenues for fiscal year 1999. Over the course of the next five years, the administration estimates that those tax credits will cost the federal government $3.64 billion.

Table 2 details the expenditures of the CCTI program for FY99.

The Clinton administration has proposed CCTI funding increases across the board for FY 2000 and additional program elements that would bring the annual cost of the CCTI to $1.37 billion. However, despite the administration's proposed expenditures for the CCTI, it is built on a shaky economic and scientific foundation. This study details the program's shortcomings. A summary of those shortcomings follows.

- The tax incentives are unlikely to have any measurable effect on energy consumption or greenhouse gas emissions.
- The CCTI's expectations for the success of research and development expenditures are like a second marriage, the triumph of hope over experience.
- The program is justified by assertions about costs and benefits that fail to pass scrutiny.

Table 1
Climate Change Technology Initiative Tax Credits, FY99

Tax Credit	Revenue Loss (in millions of dollars)
Energy-efficient building equipment	230
Energy-efficient homes	60
Rooftop solar systems	9
Electric or fuel-cell vehicles	0
Electricity produced from wind or biomass	20
Combined industrial heat and power systems	64
Total	383

Source: William Jefferson Clinton, "Report to Congress on Federal Climate Change Expenditures," April 20, 1999, p. 4.

Table 2
Climate Change Technology Initiative: Discretionary Budget Authority, FY99

Agency/Program	Budget (in millions of dollars)
DOE Building Technology Program: buildings-related R&D, developer partnerships, efficiency-rating labels, and federal energy management	124
EPA Buildings Program: "Energy Star" product promotion, small-business and school partnership programs, and federal energy management	39
HUD Partnership for Advanced Technology in Housing (PATH)	10
DOE R&D for advanced transportation technology	249
EPA R&D for advanced transportation technology and support for state and local anti-congestion and emissions reduction programs	42
DOE Industrial Technology Program: R&D for industrial applications of energy efficiency	167
EPA public-private industrial partnerships to promote energy efficiency and renewable energy technologies	19
DOE solar and renewable energy R&D	291
DOE fossil fuel R&D	20
DOE carbon sequestration R&D	14
DOE "management, planning, and analysis" of climate change	38
EPA outreach to foreign, state, and local governments to reduce greenhouse gas emissions	10
Total	1.02 (billion)

Source: William Jefferson Clinton, "Report to Congress on Federal Climate Change Expenditures," April 20, 1999, pp. 8–24.

CCTI's tax incentives are generally too short-lived to affect consumer decisionmaking, and its tax credits are too modest to change consumers' purchasing decisions.

- The CCTI concentrates on remedying market failures that do not exist.
- The performance goals of CCTI set by the administration are simply not plausible no matter how successfully the speculative R&D programs turn out.
- The entire CCTI program is premised on the idea that increased energy efficiency will reduce energy consumption, which will in turn reduce greenhouse gas emissions. However, by focusing on energy efficiency instead of carbon efficiency, the CCTI may actually be contributing to increased greenhouse gas emissions. Moreover, there is no empirical support for the argument that energy efficiency alone will reduce energy consumption.
- Even if it achieves all the advertised reductions of greenhouse gas emissions, the CCTI will have no measurable effect on climate.

The Uncreditable Tax Credits

The CCTI boasts of a blizzard of tax credits for virtually every cutting-edge renewable-energy or energy-efficient technology, and the Clinton administration projects that the myriad tax credits packaged within the CCTI will lead to major reductions in greenhouse gas emissions. However, the Energy Information Administration, an analytic agency within the Department of Energy, is dubious about such projections.

The EIA ran the tax credits through its National Energy Modeling System of domestic energy markets.[2] The EIA found that, by the year 2010, the CCTI tax credits would reduce energy consumption by only 0.09 percent and carbon emissions by only 0.17 percent.[3]

There are two fundamental problems with the CCTI's tax incentives. First, they are generally temporary and too short-lived to significantly affect consumer decisionmaking. For example, the EIA notes: "The tax credit for combined heat and power systems applies only to systems installed between 2000 and 2002. Since 18 to 36 months are required to plan, design, and install new capacity, there is not much opportunity for incremental investments in the system."[4] Another example: "Biomass gasification is assumed to be commercially available in 2005; however, since the credit expires in 2004, there is no opportunity to take advantage of the credit. Similarly, the tax credit for fuel cell vehicles extends only through 2006, when the technology is assumed by EIA to become commercially available. The date was advanced from the reference case assumption of 2010 due to the credit."[5]

The second problem with the CCTI's proposed tax incentives is that the tax credits are too modest to change consumers' purchasing decisions. As the EIA observes:

> Although the investment tax credits reduce the initial cost of purchasing the applicable equipment in buildings, transportation, and industrial sectors, the analysis assumes that consumers will continue to make decisions as indicated by EIA's analysis of historical trends. Consumers are typically reluctant to invest in more expensive technologies with long payback periods to recover the incremental costs. In addition, energy efficiency is only one of many attributes that consumers consider when purchasing new energy equipment or buildings.[6]

The Clinton administration argues that the projections by the National Energy Modeling System are invalid because the EIA conducted a stand-alone analysis of the tax credits without considering the "synergistic relationship" that allegedly exists between the tax incentives and the budgetary programs (given the speculative nature of those programs, the EIA could not quantify their benefits). Unfortunately, no evidence of this "synergistic relationship" has been offered, much less quantified in any way.[7] Moreover, the EIA points out that if any bias exists in the analysis, the bias cuts in the other direction. "It is possible that a stand alone analysis of energy efficiency policies may overstate somewhat the potential energy and carbon savings that would be seen in a fully integrated analysis of U.S. energy markets," the agency notes.

> In other words, the individual energy sector savings are not necessarily additive. As an example, some policies encourage the development and deployment of more energy-efficient and/or less carbon-intensive technologies for electricity generation. If current policies encourage energy efficiency in the end-use demand sectors and reduce the demand for electricity, however, there may be less opportunity for the generation sector to grow and invest in the new generation technologies. . . . In this analysis, however, the individual impacts of the CCTI programs are projected to be relatively small, and it is unlikely that an integrated evaluation would provide additional information.[8]

Government R&D: Hope Springs Eternal

More than half of the CCTI comprises ongoing R&D programs for energy efficiency and renewable energy. The Clinton administration is rather cavalier about predicting the future of those speculative programs. Typical is the claim that "by 2010, DOE will help develop and commercialize fuel efficiency and alternative-fuel technologies that reduce oil consumption by nearly 1 million barrels per day and reduce greenhouse gas emissions by 25 million metric tons."[9] The EIA, however, cautions rightly that

> predicting which technologies will be successful is highly speculative. A direct link cannot be established between levels of funding for research and development and specific improvements in the characteristics and availability of energy technologies. In addition, successful development of new technologies may not lead to immediate penetration in the marketplace. Low prices for fossil energy and conventional technologies; unfamiliarity with the benefits, use, and maintenance of new products; and uncertainties concerning the reliability and further development of new technologies are all factors that may slow technology penetration.[10]

The government's track record of successful energy-related R&D projects hardly gives one confidence that the R&D component of the CCTI will prove as successful as the administration claims.

One of the few serious third-party evaluations of federal R&D programs—conducted for the Brookings Institution by economists Linda Cohen of the University of California at Irvine and Roger Noll of Stanford University—found that energy R&D has been an abject failure and a pork barrel for political gain. "The overriding lesson from the case studies is that the goal of economic efficiency—to cure market failures in privately sponsored commercial innovation—is so severely constrained by political forces that an effective, coherent national commercial R&D program has never been put in place."[11]

Other dispassionate observers note that, despite the occasional R&D success, DOE expenditures for energy research have historically failed to affect energy markets at the margin. As MIT's Thomas Lee, Ben Ball Jr., and Richard Tabors observe, "The experience of the 1970s and 1980s taught us that *if a technology is commercially viable, then government support is not needed; and if a technology is not commercially viable, no amount of*

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government support will make it so."[12] Indeed, the DOE spent $19 billion on nonhydro renewable energy R&D from 1978 to 1996, but those technologies have secured only about 1.5 percent of the electricity market.[13] The $88 billion "Synfuels" debacle of the 1980s and the failed experiment in government-directed energy planning in California in the 1990s are other important examples of government's failure in reengineering the energy economy.[14]

Two government reports attempt to defend the DOE's R&D performance record. The first is a May 1995 DOE document titled "Success Stories: The Energy Mission in the Marketplace." The second, "Energy R&D: Shaping Our Nation's Future in a Competitive World," is a June 1995 report from a DOE-appointed task force on strategic energy R&D.

The former report details 61 technologies that were supported or developed by the DOE's applied research program and that were deemed "substantial economic successes" and "fundamentally important in one technical area after another in positioning U.S. industry at the forefront of global competition."[15] Despite such broad-sweeping conclusions, the report consists only of brief discussions of each "impressive" success and contains no references or citations. "Success Stories" has all the markings of a hastily put together talking paper, not a serious product.

Accordingly, Congress asked the U.S. General Accounting Office to determine whether the claims made by the DOE in the report were valid and whether "Success Stories" could be used to assess the DOE's applied R&D programs. GAO selected for examination 15 case studies (about a quarter of those listed in the report) covering all major program areas and fuel sources. Moreover, GAO chose those alleged successes that accounted for the bulk of the economic benefits identified in the report. GAO's findings were a scathing indictment not only of the report but also of the fundamental competence of the DOE itself:

> We found problems with the analyses DOE used to support the benefits cited in 11 out of the 15 cases we reviewed. These problems include basic math errors, problems in supporting economic analyses, and unsupported links between the benefits cited and DOE's role or the technology. These problems make DOE's estimates of the benefits of these cases questionable.
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> While Success Stories shows that DOE's applied R&D programs do produce some benefits, it cannot be used to assess the effectiveness of DOE's applied research programs overall because it only describes the "successes" of a very small percentage of the projects DOE has funded. In addition, Success Stories does not report how much DOE spent to support any of the technologies we evaluated. Without a comparison of costs and benefits, the successes of DOE's applied energy R&D programs cannot be determined.[16]

Nine of the 15 cases examined contained analyses replete with what GAO charitably referred to as "weak economic reasoning." For example, simply discounting the sales figures to reflect the time value of money over 32 years reduces DOE's projected value of integrated gasification combined-cycle technology (a product of the clean coal program) from $150 billion to $44 billion. Moreover, the latter figure still takes at face value DOE's optimism regarding the marketability of the technology; most analysts consider the clean coal technology program nearly as big a bust as the notorious Synfuels program. In another example, GAO found the report assumed that the total amount of money the well-drilling industry has spent on mud-pulse telemetry technology equals the amount saved by the industry.[17] In three of the cases examined, GAO also found—not at all surprisingly—that the benefits claimed were not attributable to either DOE or the technology in question.[18]

Of course, there are almost certainly energy R&D projects funded by DOE that have panned out for the taxpayer and the economy as a whole. Given the thousands of projects that have been undertaken, it would be startling if not a single one had ever provided net benefits to the economy. If the government simply dumped a million dollars out of an airplane, a few individuals would undoubtedly use the money to create societal resources worth more than the money they gathered from the ground. However, no sane economist would endorse a widespread policy of money dumping based on the results of a few such "success stories" because opportunity costs (what might we have gained had market agents—not government bureaucrats—invested the money?) must be considered. Most economists agree that market agents are more likely to efficiently allocate resources than are government planners.

The second report, from the Task Force on Strategic Energy Research and Develop-ment and known popularly as the "Yergin Report,"[19] made quite a splash. Chaired by energy celebrity Daniel Yergin, author of *The Prize* and president of the Cambridge Energy Research Associates, the task force consisted of a veritable who's who of major recipients of DOE's R&D largesse and a few of the most prominent professional advocates of federal R&D.[20] The report itself, however, was simply one more tired attempt to justify publicly funded energy R&D and a primer on how taxpayer money has been spent over the years.

Particularly interesting was this admission, conspicuously absent from DOE's "Success Stories" report:

> Many successful technologies have come out of DOE's R&D programs over the years. . . . However, the Task Force was unable to make a comprehensive assessment across all R&D programs because of the lack of meaningful and consistent metrics of performance across various groups responsible for energy R&D within DOE at this time.[21]

According to Maxine Savitz, vice chair of the task force, that is a polite way of saying that no solid data exist on which a comprehensive cost/benefit analysis can be made of DOE's energy R&D investments.[22] One might reasonably conclude that if no evidence exists to prove that DOE's R&D portfolio provides net social benefits, one should refrain from making that assertion. Unfortunately, the Clinton administration shows no such restraint.

Given the past performance of government-directed R&D, there is little reason to expect any greater success from the CCTI. That is largely because of the institutional constraints faced by politically directed R&D investment, no matter what the program.[23]

Incomplete Cost/Benefit Analysis

As it is required to do under the Government Performance and Results Act of 1993, the administration frequently offers benefit estimates for the various programs of the CCTI. The economic benefit estimates, however, are without exception highly misleading and incomplete. Typical is the administration's claim that a 20 percent tax credit to encourage the purchase of residential electric heat pumps and air conditioners will benefit the economy by encouraging investments that will ultimately save consumers billions of dollars in energy costs.

The claim is misleading because it is divorced from any discussion of the investment required to obtain those energy savings. For instance, the EIA estimates that the cost of a current-model heat pump is $4,400, while the cost of a model that would qualify for the tax credit is $5,500 (the 20 percent tax credit would, conveniently enough, cover the difference in cost). EIA data suggest that the energy-efficient heat pump will save an average of 1,676 kilowatt-hours per year.[24] Assuming a 10 percent discount rate, electricity prices of 8.3 cents per kWh, and an 11-year operating life for the heat pump, the con-

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sumer will save a total of $927 in energy costs.[25] At the very least, spending $1,100 to save $927 hardly represents a net plus for the economy. Yet the administration cites the $927 in savings as the "benefit" of the program, without making any note of the $1,100 required to secure that savings.

A calculation of consumer benefit would require a consideration of total costs: in this case, $1,100 times the total number of rebates provided plus management expenses, which would probably add another 10 to 15 percent. The total consumer benefit from purchasing the more efficient heat pump would require a calculation of the total willingness to pay minus actual payments. Once we consider that a number of participants are likely to be "free riders" (households that would have purchased the technology even without the rebate), it's likely that the benefit to consumers who would not have purchased the heat pump without the tax credit will be one-half the cost or less.

For the purposes of the CCTI, however, a cost/benefit test requires consideration of the cost of the program in relation to the reduction of greenhouse gas emissions achieved. In that case, dividing the cost of the tax credit ($1,100) by the amount of greenhouse gas emissions avoided through more efficient energy use results in a total cost of $349 per ton. With a 10 percent discount rate, the cost of reducing greenhouse gas emissions via the tax credit rises to $666 per ton.[26]

No credible economist would support a carbon tax of $666 per ton to reduce greenhouse gas emissions.

Since no credible economist would support a carbon tax of $666 per ton to reduce greenhouse gas emissions (most proposals range from $5 to $50 per ton), why should Congress accept a program that levies an implicit tax that the legislators wouldn't be caught dead advocating explicitly?[27]

Compare the above calculation with the administration's argument that for every tax dollar invested in the CCTI, $70 of economic benefits will result. If such figures were credible, one could make a pretty strong argument that *all* discretionary federal spending should be directed to the CCTI. If the administration is determined to argue the economic merits of the CCTI, it appears that a refresher course in Econ 101 would be in order.

Market-Barrier Myopia

Underlying the CCTI is the belief that market barriers—such as lack of information, shortage of investment capital, and inexplicably negative consumer biases against energy-efficiency investments—prevent the marketplace from investing optimally in the technologies.[28] The administration's heavy reliance on product labeling; demonstration projects; public awareness; and subsidized research, development, and marketing is largely designed to overcome those market barriers. DOE's and EPA's energy-efficiency performance goals will be met only if those market barriers truly affect consumer decisionmaking. If they do not, consumers will continue to reject those technologies.

Such arguments should be treated skeptically.[29] Market barriers do not necessarily contribute to economic inefficiency or suboptimal investment. As economist Ronald Sutherland explains: "A fallacy in the conservation paradigm is the presumption that market barriers produce inefficient outcomes that justify government policy. So-called market barriers may not be sources of inefficiency, but rather are benign characteristics of well functioning markets."[30] Simply put, market barriers do not necessarily induce market failures.[31]

Are the market barriers to energy-efficiency investments consequential? Conservation activists commonly cite studies indicating that residential and business consumers are routinely passing up tremendous savings in energy efficiency (known in economic jargon as demonstrating a "high discount rate," or heavily "discounting" the value of future wealth). The missed opportunities are so large, argue the activists, that those opportunities constitute prima facie evidence that market barriers to energy-efficiency investments are both real and detrimental to the economy.[32] Yet such calculations are fraught with peril, and poor technical analysis is the rule rather than the exception.[33]

In the most detailed study to date of energy-efficiency investments in the corporate world, the Denmark Institute for Local Government was forced to conclude that very few profitable investments went unrealized.[34] The potential for profitable energy savings was so small that the institute concluded that "the cost of finding electricity conservation projects [i.e., an electricity audit] is higher than the savings due to the realized investment."[35] Moreover, although "the background is experience from Danish industry, we judge the results as general for most industry."[36] Studies of consumer behavior involving home heating and cooling likewise find that the implicit rates of return used by consumers in making decisions on energy conservation investment are consistent with returns available on other investments.[37]

In sum, the estimates of unrealized savings in energy efficiency are based on engineering models that are divorced not only from consideration of opportunity cost but also from any actual consideration of individual consumers. In a "real-world" analysis of investment patterns, the unrealized savings disappear and the market barriers appear largely inconsequential. Moreover, the fact that utility-sponsored conservation programs directed at residential consumers are far less successful than programs directed at industrial consumers is at odds with the argument that residential consumers are behaving irrationally, since firms should be more savvy than households about cost control.[38]

Even if the conservationists are correct that consumers are routinely passing up profitable energy-efficiency investments, that does not necessarily imply that market barriers explain the phenomenon. The variance in energy prices over time creates uncertainty about the return on energy conservation investments. Because such investments are irreversible and more illiquid than other investments, consumers may rationally demand high returns on home conservation investments to compensate for the uncertainty of those investments.[39] High discount rates may also reflect the legitimate short planning horizons of mobile professionals, elderly people, and singles planning to marry in the future. Those rates may also reflect reasonable consumer reluctance to invest in low-demand circumstances. For instance, consumers would be rightly reluctant to pay premiums for energy-efficient bulbs to be used in cellars or for energy-efficient window-unit air conditioners, which are used during only the hottest few days of the summer. The sporadic and occasional use of such devices renders the payback period for an efficiency investment so lengthy that the investment, by any calculation, is a bad one.

As Nobel laureate F. A. Hayek noted, "An economic actor on average knows better the environment in which he is acting and the probable consequences of his actions than does an outsider, no matter how clever the outsider may be."[40] Consumers do not necessarily value energy efficiency above all other considerations, and their preferences should be accorded respect by government planners.

Think of the CCTI as made up of a bunch of economic "carrots." If the rabbits (consumers) cannot be induced by the "carrots" to purchase favored technologies, then the programs will largely fail. Since the administration's "carrots" are designed to remedy undetectable underinvestment in energy efficiency, it is unlikely that the technologies will gain enough consumer acceptance to make much difference in the overall reduction in greenhouse gas emissions. The EIA acknowledges that it is impossible to argue with certainty that programs aimed at overcoming market barriers to advanced energy technology will result in significant reductions in energy consumption.

Should the administration's programs actually manage to increase energy-efficient investments, however, the economy will be harmed, not helped. That's because we have every indication that the market at present is

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investing efficiently in such technologies. Additional government intervention to favor those investments will distort the market and lead to an inefficient overinvestment in energy efficiency.

Implausible Performance Measures

The EPA estimates that its programs will reduce annual greenhouse gas emissions by 354 million metric tons of carbon equivalent by 2010.[41] The DOE estimates that its programs will reduce greenhouse gas emissions by another 112 million metric tons of carbon equivalent,[42] yielding an estimated reduction of 452 million metric tons of greenhouse gas emissions by 2010. Those performance measures are so unrealistic that they cast doubt on the competence of the administration.

The potential for new energy-efficient technologies to reduce greenhouse gas emissions—especially within a decade—is limited.

To put that projection into perspective, the DOE's own "5-Labs" study estimates that a "high-efficiency" scenario for the economy would reduce emissions by only 120 million metric tons of carbon equivalent by 2010.[43] The EIA is less bold, suggesting that reductions of only 79 million metric tons of carbon equivalent are possible under a "high-efficiency" economic scenario.[44] Thus, the Clinton administration is now projecting that the CCTI will lead to efficiency gains four times as large as even the most optimistic projection made by its own DOE.[45]

The potential for new energy-efficient technologies to reduce greenhouse gas emissions—especially within a decade—is limited because new technologies are only incremental additions to the capital stock. Because capital stock turns over slowly and total capital stock increases with economic growth, even if the administration is correct about the benefits of its technology investments and promotional activities, there is only so much that those technologies can accomplish in the short term or the midterm.

Another reason to doubt the projections of CCTI energy savings is the dramatic failure of similar programs to reduce electricity consumption at the state level. State public utility commissions and regulated electric utility companies have spent from $16 billion to $20 billion over the past two decades subsidizing energy efficiency through "demand-side management programs" (DSM),[46] yet overall trends in electricity consumption have not been affected in any significant manner.[47] Evidence to the contrary is based on third-party engineering calculations (not actual consumption data)[48] that fail to account for "free riders";[49] ignore the reality of the "rebound," or "snap-back," effect;[50] fail to account for strategic decisionmaking on the part of consumers;[51] and fail to adequately provide for control groups in order to winnow possible confounding variables.[52] Even public utility regulators, when surveyed by the U.S. General Accounting Office, "expressed limited confidence in the accuracy of a utility's estimates of demand-side management electricity savings."[53] The fact that utilities aggressively promoting energy efficiency show no measurable declines in energy consumption compared with utilities that are less aggressive in the promotion of energy efficiency points to the empirical failure of state-directed efficiency programs.[54]

When President Clinton's Council of Economic Advisers produced a plan to comply with the Kyoto Protocol at the lowest possible economic cost, the council ignored the DOE's and the EPA's claims about the potential for the CCTI to significantly reduce greenhouse gas emissions. Instead, the CEA report relied on a liberal emissions trading program to reduce greenhouse gases and made no mention of the CCTI's ability to contribute to Kyoto compliance.[55] If the DOE's and the EPA's claims of program savings could not persuade the administration's own economists to include such claims in its main planning document, the claims should probably not be taken seriously by Congress.

Energy Efficiency May Hinder Carbon Efficiency

A fundamental problem with the CCTI is its focus on reducing energy consumption rather than reducing greenhouse gas emissions. If electricity were generated largely by natural gas and nuclear power, it would make little difference how efficient our end-use technologies were; greenhouse gas emissions would be minimal either way. In fact, the CEA relies on the elimination of the domestic coal industry and the accelerated emergence of natural gas–fired electricity to meet the standards of the Kyoto Protocol.[56] Correspondingly, if electricity were generated largely by coal, increased efficiency would do little to control total greenhouse gas emissions. Those distinctions, however, are largely ignored in the CCTI, and the upshot is that the program could well end up doing as much harm as good.

Consider, for instance, advanced water heaters. Among the most efficient water heaters on the market are electric heat pumps with an "energy factor" of 1.65 (the higher an appliance's energy factor, the more energy efficient the appliance is). The most efficient gas water heaters, however, have an energy factor of only .54. Under the administration's plan, the electric heat pump would qualify for a 20 percent tax credit and would be aggressively promoted by the government. According to the DOE's own data, however, the electric heat pump would generate 4,872 pounds of carbon dioxide a year compared with 3,862 pounds of carbon dioxide a year generated by the natural gas heater.[57]

The reason is simple. Approximately 70 percent of the total energy consumed by an appliance is actually consumed in the production, generation, transmission, and distribution of energy. Since more electricity is generated from coal than from any other fuel source, the "energy efficient" electric heat pump would be inferior—from a greenhouse gas emissions standpoint—to the less-efficient natural gas heat pump.

That is but one of many examples that show that the CCTI's concentration on energy efficiency may work at cross purposes with its stated goal of reducing greenhouse gas emissions.

Correlation between Energy Efficiency and Energy Consumption Is Unsure

Aside from the difficulty in reconciling energy efficiency with carbon efficiency, the suggestion that increased energy efficiency as a program output will lead to reduced energy consumption as an intermediate outcome is questionable. The reason is that improving technical energy efficiency reduces the cost, and thereby tends to increase the consumption, of goods and services that use energy. Thus, depending on the elasticity of demand for the energy service in question, the increased energy consumption that results will offset some if not all the gains achieved by enhanced energy efficiency.

For example, assume that DOE helps develop and market an incredibly energy-efficient air conditioner. The upshot is that residential consumers will be able to substantially reduce the cost of keeping their homes at 75 degrees in the summer. Perhaps, however, many consumers are most comfortable if indoor temperatures are 70 degrees. Although those residents might not have been able to afford to keep the thermostat that low in the past, thanks to DOE's new air conditioner, now they can. So the thermostat is lowered, energy consumption increases, and greenhouse gas emissions go back up.

As mentioned earlier, economists who have studied the relationship between energy efficiency and increased energy consumption (sometimes known as the "rebound" effect) have documented the correlation.[58] We can also see that phenomenon by examining macroeconomic data. According to the EIA, energy efficiency (measured as total energy consumption per unit of GDP) improved by 57 percent from 1949 to 1997. Yet total energy consumption increased by 323 percent

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At best, the CCTI will reduce temperatures by .0091 °C below where they otherwise would be by 2050.

over that same period. Population growth, economic growth, and the "rebound" effect are the main reasons for that lack of correlation between energy efficiency and energy consumption.

The only effective way to reduce greenhouse gas emissions is to *increase* the costs of energy produced by fossil fuels at the margin to such an extent that consumers purchase less of it. *Reducing* the marginal cost of energy services powered by fossil fuels will not significantly reduce greenhouse gas emissions.[59]

CCTI's Empty Promise

When President Clinton signed the Government Performance and Results Act, he argued that government programs should be judged by how they might tangibly affect the American people. For every program, President Clinton said we should ask: "Is it changing people's lives for the better? Can we say after we take money and put it into a certain endeavor that it was worth actually [taking] away from the taxpayers [and putting] into this endeavor and [that] their lives are better?"[60] In the case of the CCTI, there are two appropriate questions to ask. First, to what degree will these programs abate global warming? Second, how will the American public then benefit from the abatement of global warming?

Unfortunately, the administration refuses to specify how the CCTI will affect America.[61] Let's try to construct such an assessment. For the sake of argument, assume the above critique of the program is incorrect and that the administration's claims can all be taken at face value. Assume, therefore, that the CCTI meets all the performance measures and results offered by the administration.

If every nation meets its commitments under the Kyoto Protocol, the world's most advanced climate model predicts that by the year 2050 temperatures will be 0.07 degree Celsius cooler than they otherwise would be under a business-as-usual scenario.[62] Since the United States emits 20 percent of the world's greenhouse gases, we can infer that U.S. compliance with the Kyoto Protocol would reduce global temperatures by 0.014 °C. According to the DOE and the EPA, their contribution to the CCTI will reduce greenhouse gas emissions by 452 million metric tons of carbon equivalent a year by 2010 (the midpoint of the Kyoto compliance period). That means that about 65 percent of the greenhouse gas emission reductions required of the United States under the Kyoto Protocol can be made through the CCTI, implying that the CCTI will reduce temperatures by .0091 °C (16/1,000ths of a degree Fahrenheit) below where they otherwise would be by 2050.

Such a change in temperature is too small to measure. Moreover, this infinitesimal reduction in temperature would not affect the lives of the American people one whit. When the EPA was asked by Congress to critique the above analysis, the agency refused comment.[63]

Conclusion

Even if one believes in the importance of taking immediate action to reduce greenhouse gas emissions, one cannot help but conclude that the CCTI is a sham, a repackaging of failed programs and inconsequential tax credits that together—even under the most optimistic assumptions—will do nothing to significantly reduce global temperatures. Congress should eliminate funding for the initiative and all of its programs.

Notes

1. Other programs include the $1.7 billion U.S. Climate Change Research Program; $157 million of miscellaneous international assistance programs administered by the U.S. Agency for International Development; and a grab bag of other programs, such as the EPA's Clean Air Partnership Fund, the DOE's Weatherization and State Energy Grants, the Partnership for a New Generation of Vehicles Initiative, and U.S. contri-

butions to the Global Environmental Facility. The programs cost a total of $558 million and are alleged by the administration to offer secondary benefits that may help reduce greenhouse gas emissions. William Jefferson Clinton, "Report to Congress on Federal Climate Change Expenditures," April 20, 1999, pp. 1–2.

2. The EIA's National Energy Modeling System represents with a high degree of detail energy-consuming and energy-producing technologies, yet uncertainties inevitably exist about the pace of technological development and market penetration. To project future energy markets, the National Energy Modeling System relies on engineering evaluations of availability, costs, and characteristics of new technologies, as well as continuing patterns of R&D. Energy Information Administration, "Analysis of the Climate Change Technology Initiative," SR/OIAF/99-01, April 1999, p. ix.

3. Ibid., p. xi.

4. Ibid., p. xii.

5. Ibid.

6. Ibid., pp. xi–xii.

7. See David Gardiner, assistant administrator for policy, Environmental Protection Agency, Testimony before the Subcommittee on Energy and Environment of the House Committee on Science, 106th Cong., 1st sess., April 14, 1999, pp. 6–10; and Dan Reicher, assistant secretary for energy efficiency and renewable energy, U.S. Department of Energy, Testimony before the Subcommittee on Energy and Environment of the House Committee on Science, 106th Cong., 1st sess., April 14, 1999.

8. Energy Information Administration, "Analysis of the Climate Change Technology Initiative," p. 8.

9. Clinton, "Federal Climate Change Expenditures," p. 14.

10. Energy Information Administration, "Analysis of the Climate Change Technology Initiative," p. xv.

11. Linda Cohen and Roger Noll, *The Technology Pork Barrel* (Washington: Brookings Institution, 1991), p. 378.

12. Thomas Lee, Ben Ball Jr., and Richard Tabors, *Energy Aftermath* (Boston: Harvard Business School Press, 1990), p. 167. Emphasis in original.

13. Robert L. Bradley, "Renewable Energy: Not Cheap, Not 'Green,'" Cato Institute Policy Analysis no. 280, August 27, 1997, p. 63.

14. Robert L. Bradley, "The Increasing Sustainability of Conventional Energy," Cato Institute Policy Analysis no. 341, April 22, 1999, pp. 30–32.

15. U.S. Department of Energy, "Success Stories: The Energy Mission in the Marketplace," May 1995, p. 1.

16. General Accounting Office, Letter to the Honorable John Kasich, Chairman, House Committee on the Budget, April 15, 1996, GAO/RCED-96-120R, pp. 1–2.

17. Ibid, p. 5.

18. Ibid.

19. Secretary of Energy Advisory Board, "Energy R&D: Shaping Our Nation's Future in a Competitive World," Final report of the Task Force on Strategic Energy Research and Development, U.S. Department of Energy, June 1995.

20. Corporate members of the task force included Maxine Savitz of Allied Signal Ceramic Components, Michael Baly of the American Gas Association, Michael Bonsignore of Honeywell Inc., Bobby Brown of CONSOL Inc., William Burnett of the Gas Research Institute, Stephen Dean of Fusion Power Associates, Linn Draper Jr. of American Electric Power, Roger Herbert of Baker Hughes Oilfield Operations, Fritz Kalhammer of the Electric Power Research Institute, Robert Kelly of Amoco/Enron Solar Power Development, Regis Matzie of ABB Combustion Engineering, Mark Murphy of Strata Production Co., Roger Naill of AES Corp., Lawrence Papay of Bechtel, Larry Smith of Shell Oil Co., Richard Stegemeier of Unocal, Leonard Wohadlo of National Power Co., and James Wolf of Honeywell. Consultants and university directors on the task force included energy consultant Mason Willrich, Kofi Bota of Clark-Atlanta University, Elisabeth Drake of MIT, H. M. Hubbard of the Pacific International Center for High Technology Research, Franklin Orr Jr. of Stanford University, Marc Ross of the University of Michigan, David Shirley of Pennsylvania State University, and Susan Nardone of Cambridge Energy Research Associates. Professional advocates included Ralph Cavanagh of the National Resource Defense Council and Scott Sklar of the U.S. Export Council for Renewable Energy. Finally, two state bureaucrats were included: Larry Bean of the Iowa Department of Natural Resources and Ronald Eachus of the Oregon Public Utilities Commission.

21. Secretary of Energy Advisory Board, p. 43.

22. Telephone conversation with the author, July 22, 1996.

23. Jerry Taylor, Testimony before the Subcommittee on Energy and Environment of the House Committee on Science, 105th Cong., 1st sess., April 9, 1997.

24. Ronald Sutherland, "The Feasibility of 'No Cost' Efforts to Reduce Carbon Emissions in the U.S.," Issue Analysis no. 106, American Petroleum Institute, May 1999, pp. 21–22.

25. Even this calculation, however, is too generous because the marginal rather than the average cost of electricity is the appropriate consideration. Since marginal electricity costs are less than half of average costs, the calculation overestimates the savings possible from the heat pump.

26. Sutherland, "The Feasibility of 'No Cost' Efforts to Reduce Carbon Emissions," pp. 20–21.

27. Even William Cline, a highly respected economist of the Institute for International Economics, concludes that the costs of countering global warming will far exceed the benefits and proposes no more than a $250 per ton carbon tax. See William Cline, *The Economics of Global Warming* (Washington: Institute for International Economics, 1992), p. 294. Economist Thomas Gale Moore, however, argues that Cline's cost/benefit analysis is deeply flawed and far too alarmist. See Thomas Gale Moore, *Climate of Fear: Why We Shouldn't Worry about Global Warming* (Washington: Cato Institute, 1998), pp. 109–28. For a partially concurring view, see Robert Mendelsohn, "The Greening of Global Warming," AEI Studies on Global Environmental Policy, American Enterprise Institute, 1999.

28. For a review of the alleged market barriers, see Fereidoon Sioshansi, "The Myths and Facts of Energy Efficiency; Survey of Implementation Issues," *Energy Policy* 13 (1991): 231–42; and Roger Carlsmith et al., "Energy Efficiency: How Far Can We Go?" ORNL/TM-11441, Oak Ridge National Laboratory, January 1990, pp. 26–30.

29. For an overview of the debate on the possible effects of market barriers, see *Energy Policy* 22, no. 10 (October 1994), an issue devoted entirely to the controversy; and Stanford Energy Modeling Forum, "Markets for Energy Efficiency," Report 13, September 1996.

30. Sutherland, "The Feasibility of 'No Cost' Efforts to Reduce Carbon Emissions," p. 9.

31. "Market failure" is classically understood as a situation in which pricing mechanisms are incapable of capturing the full social cost or social benefits of an economic activity ("externalities" in economic parlance). That phenomenon is usually attributable to obstacles to market exchanges that interfere with or discourage efficient transactions ("transactions cost"). Such obstacles are primarily encountered in the provision of "public goods," generally defined as goods or services that enable nonpaying individuals to enjoy the benefits of consumption paid for by others (national defense is a typical example). Public goods are also typified by "nonrivalrous competition," a condition that exists when an individual's ability to consume a good or service is not diminished by allowing other individuals to consume that same good or service.

The two classic statements of the theory of market failure are found in Paul Samuelson, "The Pure Theory of Public Expenditure," *Review of Economics and Statistics* 36 (November 1954): 387–89; and Francis Bator, "The Anatomy of Market Failure," *Quarterly Journal of Economics* 72 (August 1958): 351–79. Both essays were reprinted in Tyler Cowen, ed., *The Theory of Market Failure: A Critical Examination* (Fairfax, Va.: George Mason University Press, 1988), pp. 29–33 and 35–66, respectively. Although market barriers may exist in the provision of energy efficiency, they by no means are symptoms of an underlying market failure classically understood. Unfortunately, few analysts in Washington appreciate the distinction, and misunderstanding about the subject is rife. See Steven Kelman, *What Price Incentives?* (Boston: Auburn House, 1981), chap. 3.

32. Representative arguments are Alliance to Save Energy et al., "America's Energy Choices: Investing in a Strong Economy and a Clean Environment," Union of Concerned Scientists, 1991.

33. Consumer reluctance to purchase commercial lighting ballasts is a premier example of market failure that was used by the energy conservation lobby to justify government intervention in energy markets. Yet the conclusion that "market failure" explained such consumer reluctance is riddled with errors. See Paul Ballonoff, "On the Failure of Market Failure," *Regulation* 22, no. 2 (1999): 17–19.

34. The Denmark Institute originally speculated that corporate energy efficiency could be improved by 42 percent through full use of cutting-edge technology, but after several years of extensive, on-site analysis the institute concluded that only a 3.1 percent gain in energy efficiency could be realized through profitable energy efficiency investments. Mikael Togeby and Anders Larsen, "The Potential for Electricity Conservation in Industry: From

Theory to Practice," Proceedings from the 18th International Association for Energy Economics International Conference, in *Into the 21st Century: Harmonizing Energy Policy, Environment, and Sustainable Economic Growth* (Cleveland, Ohio: International Association for Energy Economics, 1995), pp. 48–55.

35. Ibid., p. 54.

36. Ibid., p. 48.

37. Albert Nichols, "How Well Do Market Failures Support the Need for Demand Side Management?" National Economic Research Associates, Cambridge, Mass., August 12, 1992, pp. 22–25; and Ruth Johnson and David Kaserman, "Housing Market Capitalization of Energy-Saving Durable Good Investments," *Economic Inquiry* 21 (1983): 374–86.

38. Steven Nadel, "Lessons Learned: A Review of Utility Experiences with Conservation and Load Management Programs for Commercial and Industrial Customers," Paper prepared for New York State Energy Research and Development Authority, American Council for an Energy-Efficient Economy, 1064-EEED-AEP-88, 1990; and Paul Joskow and Donald Marron, "What Does a Negawatt Really Cost? Evidence from Utility Conservation Programs," *Energy Journal* 13, no. 4 (1992): 41–74.

39. Kevin Hassett and Gilbert Metcalf, "Energy Conservation Investment: Do Consumers Discount the Future Correctly?" *Energy Policy* 21 (June 1993): 710–16; Gilbert Metcalf, "Economics and Rational Conservation Policy," *Energy Policy* 22 (October 1994): 819–25; and Avinash Dixit and Robert Pindyck, *Investment under Uncertainty* (Princeton, N.J.: Princeton University Press, 1994).

40. Friedrich von Hayek, "The Use of Knowledge in Society," *American Economic Review* 35 (1945): 519–30.

41. Gardiner.

42. Reicher.

43. Interlaboratory Working Group, "Scenarios of Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond," Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, September 1997, quoted in Sutherland, "The Feasibility of 'No Cost' Efforts to Reduce Carbon Emissions," p. 4.

44. Energy Information Administration, "Annual Energy Outlook 1998," DOE/EIA-0383, U.S. Department of Energy, December 1997, p. 193.

45. That is particularly striking given the wildly optimistic assumptions made by DOE in its 5-Labs study. For a critique of the study, see Ronald Sutherland, "A Critique of the 'Five Lab' Study," American Petroleum Institute, June 1998.

46. Bradley, "Renewable Energy," p. 36.

47. The amount of electricity required to produce a unit of U.S. gross domestic product grew by 7 percent from 1978 (the date that Congress passed the Public Utility Regulatory Policies Act—PURPA—the federal law that provided the foundation for energy efficiency subsidies in the economy) through 1997, a figure roughly equivalent to the growth in the electricity intensity of non-U.S. OECD nations. Since U.S. public utility commissions and investor-owned electricity firms have subsidized energy efficiency to a far greater degree than have their European counterparts, it is clear that those U.S. organizations have been unable to affect overall trends in electricity consumption. See Franz Wirl, *The Economics of Conservation Programs* (Boston: Kluwer Academic Publishers, 1997), pp. 186–87, 204. Present data on electricity intensity trends were calculated by the author from *Economic Report of the President* (Washington: Government Printing Office, 1999), p. 328; Energy Information Administration, "Annual Energy Review Interactive Data Query System," http://tonto.eia.doe.gov/aer/; and International Energy Agency, "World Energy Statistics Diskettes," 1999.

48. Nadel and Keating's survey of 200 such utility-sponsored programs found that "savings figures are generally based on engineering estimates" and that "more sophisticated estimates of actual savings are rarely available." Joskow and Marron likewise conclude that the energy savings estimates provided by the utilities are utterly unverifiable, although Nadel and Keating, in a survey of 42 programs, found that the actual rather than projected energy savings from such programs averaged 63 percent below the engineering estimate. See Steven Nadel and Kenneth Keating, "Engineering Estimates versus Impact Evaluation Results: How Do They Compare and Why?" in *Energy Program Evaluations: Uses, Methods and Results*, Proceedings of the 1991 International Energy Program Evalu-ation Conference, 1991.

49. The few detailed analyses of the phenomenon indicate that 50 to 60 percent of the participants in utility-sponsored efficiency programs would have invested in the technologies regardless of the subsidy. See Joskow and Marron. Wirl, pp. 141–42, argues, moreover, that many of the analyses that acknowledge free riding do

not account sufficiently for that phenomenon. Accordingly, Wirl, p. 188, concludes that "the utility can 'prove' to save substantial amounts of energy, because consumers choose very inefficient appliances (e.g., not a single SL-18 bulb), but neglects that this 'conservation' is due to the fact that conservation programs deter individual actions. In other words, the 'efficiency' of DSM becomes a self-fulfilling prophecy saving numerous kWhs on paper but few in practice."

50. Wirl, pp. 31, 195, 203. Economists (as opposed, apparently, to policymakers) are well aware that improving technical energy efficiency reduces the cost, and thereby tends to increase the consumption, of goods and services that use energy. The degree to which energy efficiency gains will lead to increases in energy consumption depends on the elasticity of demand for each affected energy service. Unfortunately, "the rebound effect seems important for services with a significant conservation potential but negligible for services with a minor conservation potential in terms of kWhs." The rebound effect applies to firms as well. Wirl, p. 43, notes that "increasing the efficiency [of a device] by 1 percent lowers the costs of the service by 1 percent. As a consequence, this now cheaper input is used to substitute for other inputs, capital and labor, and this expansion [of energy use] dominates the gain in the production of [energy] itself."

For empirical documentation of the rebound effect, see J. D. Khazzoom, "Economic Implications of Mandated Efficiency Standards," *Energy Journal* 1, no. 4 (1980): 21–39; idem, *An Econometric Model Integrating Conservation in the Estimation of the Residential Demand for Electricity* (Greenwich, Conn.: JAI Press, 1986); idem, "Energy Savings Resulting from the Adoption of More Efficient Appliances," *Energy Journal* 8, no. 4 (1987): 85–89; idem, "Energy Savings from More Efficient Appliances: A Rejoinder," *Energy Journal* 10, no. 1 (1989): 85–89; Jeffrey Dubin, Allen Miedema, and Ram Chandran, "Price Effects of Energy-Efficient Technologies: A Study of Residential Demand for Heating and Cooling," *RAND Journal of Economics* 17 (1986): 310–25; Eric Hirst, "Changes in Indoor Temperature after Retrofit Based Electricity Billing and Weather Data," *Energy Systems and Policy* 10 (1987): 1–20; H. D. Saunders, "The Khazzoom-Brooks Postulate and Neoclassical Growth," *Energy Journal* 13, no. 4 (1992): 131–48; F. P. Sioshansi, "Do Diminishing Returns Apply to DSM?" *Electricity Journal* 7, no. 4 (May 1994): 70–79; Paul Joskow, "Utility-Subsidized Energy-Efficiency Programs," *Annual Review of Energy and the Environment* 20 (1995): 526–34; and David Greene and L. A. Greening, "Energy Use, Technical Efficiency, and the Rebound Effect: A Review of the Literature," Report to the Office of Policy Analysis and International Affairs, U.S. Department of Energy, December 1997. For a review of the literature on the rebound effect and automobile transportation, see David Greene, James Kahn, and Robert Gibson, "Fuel Economy Rebound Effect for U.S. Household Vehicles," *Energy Journal* 20, no. 3 (1999): 6–10.

51. Wirl, pp. 119–42. Wirl, p. 198, concludes that energy-efficiency interventionists are unduly optimistic because they "overlook the fact that DSM, intended to correct for market failures, introduces new distortions. In other words, the so far implicit assumption of passive consumers—DSM does not affect the consumers' initial choices of equipment—is untenable, because consumers will manipulate programs when it is to their advantage."

52. Wirl, p. 125, explains that most "controlled" studies of state-sponsored conservation programs simply attempt to ascertain whether an energy-efficient investment was made by the group favored with the subsidy compared with the group that was not. Yet, Wirl continues, "It seems impossible to infer how many consumers" invested because of the subsidy or because of the simple need to replace aging equipment (new equipment almost always being more energy efficient than older equipment). "Moreover, even if the program triggered some advanced replacements quantifiable for the year following the program, the question remains for how many years to count this conservation. This is the reason why even the comparison with a control group cannot quantify the conservation, unless data is sampled for several years."

53. U.S. General Accounting Office, "Electricity Supply: Utility Demand-Side Management Programs Can Reduce Electricity Use," GAO/RCED-92-13, October 1991, p. 29.

54. Andrew Rudin, energy consultant, Presentation before the Florida Public Service Commission, August 17, 1992.

55. Council of Economic Advisers, "The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis," July 1998.

56. Peter VanDoren, "The Costs of Reducing Carbon Emissions: An Examination of Administration Forecasts," Cato Institute Briefing Paper no. 44, March 11, 1999.

57. Data from U.S. Department of Energy, "Energy Efficiency Standards for Consumer Products," Technical support document, 1993, relayed by Charles Fritts, American Gas Association, May 17, 1999.

58. See Joskow and Marron; and Wirl.

59. See L. Brookes, "The Greenhouse Effect: The Fallacies in the Energy Efficiency Solution," *Energy Policy* 18, no. 2 (1990): 199–201.

60. William Jefferson Clinton, Remarks on signing the Government Performance and Results Act of 1993; and William Jefferson Clinton, "Public Papers of the Presidents," Exchange with reporters, August 3, 1993.

61. Peter Guerrero, of the U.S. General Accounting Office, "Climate Change: Observations on the April 1999 Report on Climate Change Programs," Testimony before the Subcommittee on Energy Research, Development, Production and Regulation of the Senate Committee on Energy and Natural Resources and the Subcommittee on National Economic Growth, Natural Resources and Regulatory Affairs of the House Committee on Government Reform, GAO/T-RCED-99-199, 106th Cong., 1st sess., May 20, 1999.

62. Thomas Wigley, "The Kyoto Protocol: CO2, CH4, and Climate Implications," *Geophysical Research Letter* 25 (1998): 2285–88.

63. Environmental Protection Agency, "EPA Responses to Follow-Up Questions from the May 20, 1999, Joint House/Senate Hearing on Global Climate Change," 106th Cong., 1st sess., June 23, 1999, pp. 11–12.

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