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# THE ECONOMIC FALLACIES OF DEMAND-SIDE MANAGEMENT

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# THE ECONOMIC FALLACIES OF DEMAND-SIDE MANAGEMENT

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# EXECUTIVE SUMMARY

Recent years have seen the emergence of Demand-Side Management (DSM), a new approach to the electricity utility planning process. Through DSM programs, utilities endeavor to diminish ratepayer demand to avoid supply costs and capacity expansion. Such programs typically encourage ratepayers to adopt energy efficient lighting, heating, ventilating and air-conditioning systems, additional heat insulation, and other energy-saving investments, offering partial or total subsidies for purchase and installation. As an inducement, shareholder-owned utilities are permitted to recover their DSM capital investments and revenue losses by raising their rates.

DSM is premised on the notion that the self-interest of individuals is in conflict with their behavior: Despite the availability of numerous cost-effective energy efficiency investments, consumers have failed to adopt them.

DSM theory classifies this apparent paradox as a species of "market failure." In this view, the market imperfectly disseminates information about the profitability of energy efficiency investments. However, this paradox may result from overestimation of the benefits of energy efficiency investments. In particular, DSM overestimates the benefits of energy efficiency investments by:

- only comparing investment options to the exclusion of other relevant choices faced by energy consumers;

- neglecting the non-monetary cost components of investments, including transaction costs, measurement and evaluation costs, the risks and uncertainties associated with the investment, its quality of service, and others which often exceed the investment price of the asset significantly; and

- ignoring the fact that true costs and benefits cannot be measured, since they are subjectively experienced by individuals and therefore cannot be discerned by external observers.

Thus, the perceived market failure may be more accurately attributed to overestimation of the cost-effectiveness of energy efficiency improvements rather than the failure of energy markets.

The enormous informational obstacles (i.e., the inability to accurately measure costs and benefits) faced by DSM users raises an important question: Why, given such glaring flaws, is it being attempted on such a grand scale? The answer may be found in the incentives which confront the

utilities, their larger commercial and industrial customers, their PUCs, purveyors of energy efficient technologies, environmental activists, and other DSM proponents.

DSM may more properly be seen as an attempt by various interested parties to extract rents from others. For instance:

- Energy utilities see DSM as a means to improve their financial condition.
- The PUC is able to distort its own performance, making it less accountable to those who appoint the commissioners, and ultimately to the public at large.
- Environmentalists see DSM as a way to connect the economic interest of utilities to the realization of their own ideological goals, which include a dramatic reduction in fossil fuel consumption and the consequent pollution.
- Large commercial and industrial utility customers are subsidized, which allow them to invest in energy efficiency at the ratepayer's expense.
- DSM theorists, consultants and planners have made a cottage industry of DSM planning. They do not wish to see their jobs eliminated.
- Producers of energy efficient technologies benefit enormously from the inflated demand for their products. These are all natural supporters of DSM and other subsidy schemes.

In its current form, DSM would be impossible without the monopoly power of the utility, which allows it to raise rates and cross-subsidize DSM program participants. In recent years industrial power consumers are beginning to demand access to the wholesale electricity market, bypassing the monopoly utility. This process is known as "retail wheeling" and would render most DSM programs impossible.

DSM is flawed both in theory and practice. Its theoretical foundation rests on the discredited theories of central economic planning, which presume that governmental and quasi-governmental institutions have the knowledge and incentives to economize on behalf of individuals.

DSM's success can be effectively explained with a public choice model that understands it as a "racket," or a scheme to enable rent-seeking on the part of special interests. It is largely opposed by commercial and industrial ratepayers, which seek to reduce its cross-subsidization effects and clear the way for competitive electricity markets. The outcome of that struggle will ultimately determine the fate of DSM, as well as the nature of the electricity industry in the United States.

# THE ECONOMIC FALLACIES OF DEMAND-SIDE MANAGEMENT

by Matthew C. Hoffman

## INTRODUCTION

Recent years have seen the emergence of Demand-Side Management (DSM), a new approach to the electricity utility planning process. Through DSM programs, utilities endeavor to diminish ratepayer demand to avoid supply costs and capacity expansion. Such programs typically encourage ratepayers to adopt energy efficient lighting, heating, ventilating and air-conditioning systems, additional heat insulation, and other energy-saving investments, offering partial or total subsidies for purchase and installation. As an inducement, shareholder-owned utilities are permitted to recover their DSM capital investments and revenue losses through rate base incorporation.

*Through DSM programs, utilities endeavor to diminish ratepayer demand to avoid supply costs and capacity expansion.*

DSM programs are subsumed in the overall planning process of utilities in a process known as Integrated Resource Planning (IRP), or Least-Cost Planning (LCP). Utility IRP programs compare the costs and benefits attached to traditional utility supply options (additional generating and transmission capacity) to DSM. Ideally, this results in an allocation of the most cost effective mix of "supply-side" and "demand-side" resources.

The purpose of this paper is to present a thorough examination and critique of DSM theory. This will begin with a review of the history of the DSM concept. Then, the paper offers a critical analysis of the "adoption paradox" exhibited in energy efficiency markets, DSM "efficiency" criteria (the Total Resource Cost Test, Societal Test, and Rate Impact Measure), and DSM measurement and evaluation. Finally, the paper analyzes the economic motives of DSM proponents, and examines the alternative presented by retail wheeling and competitive markets.

## HISTORICAL BACKGROUND

The gestation of the DSM concept began during the intense energy controversies of the mid-1970s, when social and economic trends converged to sweep energy policy into the national consciousness. The Arab oil embargo against the United States, combined with strict price controls on gasoline and other petroleum products, had created alarming shortages and lengthy queues at the gasoline pump. Moreover, the burgeoning environmental movement was successfully propagating a neo-malthusian vision of impending natural resource depletion. Prophets of environmental armageddon, most notably Paul Ehrlich, an entomologist at Stanford University, and a technocratic group known as the "Club of Rome," were featured prominently in the media. Although their predictions had little basis in fact and proved widely inaccurate, the frightful nature of their premonitions made a lasting impression on the American public.[1] Reducing fossil fuel dependence, both to secure national economic independence and conserve natural resources, was perceived as an unquestionable imperative.

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Most proposed solutions for the "energy crisis" consisted of mild programs of national asceticism, including elevated taxes on energy use, a uniform 55 mph speed limit, and new public transportation initiatives. But in a 1976 article in *Foreign Affairs*,[2] an environmental activist with impeccable malthusian credentials[3] revealed a revolutionary new approach to the issue, one that permanently altered the terms of the energy debate. He was Amory Lovins, then-British representative of Friends of the Earth.[4]

Lovins pointed out that the growing energy needs of individuals and corporations could be met in two ways, which he labeled energy "paths." The "hard" energy path led to the construction of additional power plants, and a concomitant acceleration of natural resource depletion. The "soft" path, which Lovins proposed as an alternative, consisted of reducing energy demand by increasing energy efficiency. Instead of taking the hard path by producing additional megawatts, America could take the soft path, and manufacture "negawatts."

If homes and businesses adopted a myriad of energy efficiency improvements, including more efficient lighting, heating and cooling systems, and improved building insulation, they could reduce their energy use and simultaneously lower their cost of living, Lovins argued. In other words, they could have their cake and eat it too; natural resource depletion would be mitigated, and living standards would actually rise as a result.

In the economist's ideal world of "perfect competition," such cost-effective energy efficiency improvements would be immediately adopted by self-interested individuals, without any additional incentives. However, Lovins observed, the marketplace is highly imperfect. He found this particularly evident in the market for energy efficiency, where adoption rates were suppressed by a complex of factors, including obsolete building codes, union influence, and lack of centralized government power. To compensate, he opined, government should provide tax incentives for the adoption of energy efficient technologies, and undertake educational campaigns to promote them.

Lovins' article set off a firestorm in the environmental movement. Although many conservation activists were skeptical of Lovins' claims, analysts at the Environmental Defense Fund (EDF) endeavored to apply his theory to the problems of electricity utility regulation. In a series of hearings at the California Public Utilities Commission during the late 1970s and early 1980s, EDF argued that the Pacific Gas and Electric Company of San Francisco could lower its total costs by investing in energy efficiency for its customers (and therefore diminishing their electricity demand), rather than building new power plants. Their labors, according to EDF attorney David Roe, resulted in the overhauling of PG&E's capacity expansion plan.[5] PG&E abandoned most of its new plant construction plans in favor of energy efficiency programs.

EDF's creative application of Lovins' approach to electricity utilities was dubbed "Demand-Side Management" (DSM), a concept that began to spread rapidly among utilities during the 1980s. Today, hundreds of utility DSM programs seek to induce ratepayers to diminish their consumption of electricity by improving their energy efficiency. Typical programs partially or fully subsidize the purchase and installation of energy-efficient air conditioners, heat pumps, fluorescent lighting, and additional insulation in the homes and businesses of utility customers. Suppressing customer demand enables the utility to avoid the cost of constructing new power plants and producing additional units of electricity.

*Today, hundreds of utility DSM programs seek to induce ratepayers to diminish their consumption of electricity by improving their energy efficiency.*

During the late 1980s, utilities began to experience additional pressure to adopt DSM programs as a new environmental "crisis" loomed on the horizon: "global warming." According to the global warming theory, increasing atmospheric concentrations of carbon dioxide and other trace gasses were causing the lower strata of the Earth's atmosphere to warm, with potentially disastrous results.[6] As fossil fuel consumption is a primary source of carbon dioxide emissions, DSM had a new and powerful rationale.

As the decade closed, the concept of Integrated Resource Planning (IRP) was formulated to create a grand unified theory, as it were, of utility planning, incorporating both the traditional "supply side" approach of producing electricity and constructing power plants, and the "demand side" approach of DSM. In the IRP process, supply-side and demand-side options were to be compared on a "level playing field," and the "least cost" mix was to be selected. Ideally, investor-owned utilities would profit equally from the two approaches.[7]

In the years that followed, DSM and IRP continued to gain acceptance among electricity utilities. According to the Electric Power Research Institute, over 50 percent of electric utilities have adopted DSM programs. In 1992, IRP became the law of the land, mandated by the Energy Policy Act. Today, at least in theory, all utilities must compare "demand-side" and "supply-side" investment options. Demand-Side Management is an increasingly entrenched approach to utility planning.

*Over 50 percent of electric utilities have adopted DSM programs.*

## CONFRONTING THE "ADOPTION PARADOX"

Demand-Side Management is premised on the notion that the self-interest of individuals is in conflict with their behavior: Despite the availability of numerous cost-effective energy efficiency investments, consumers have failed to adopt them. This divergence of self-interest and observed behavior is known as the "adoption paradox."

*DSM biases its estimates of energy efficiency cost effectiveness.*

DSM theory classifies the adoption paradox as a species of "market failure," and prescribes a complex of corrective measures. In this view, the market imperfectly disseminates information about the profitability of energy efficiency investments, and suffers from a number of structural defects. But the "adoption paradox" may derive from two other sources: the overestimation of the benefits of energy efficiency investments, and the underestimation of energy efficiency adoption rates.

Although there is little reason to believe that the adoption rates for energy efficient technologies have been misreported, the methods employed in estimating the net benefits of energy efficiency investments are often inadequate and biased. They systematically underestimate the costs of the investments, and often incorrectly identify those costs with market failures. Rather than representing market failures, the adoption paradox suggests the inadequacies of DSM theory itself.

**Measuring Cost-Effectiveness**

The adoption paradox derives from the DSM proponent's assessment of the costs and benefits of energy efficiency investments. Unfortunately, as economists have long recognized, costs and benefits are subjectively experienced by individuals and therefore cannot be discerned by external observers.[8]

In lieu of examining the actual costs and benefits attached to energy efficiency investments, DSM theory compares the rate of return on energy efficiency investments to other common investments (savings accounts, blue chip stocks, and government bonds). If the rate of return on the energy application is higher, the investment is deemed "cost-effective."[9]

*DSM theory fails to account for the non-monetary benefits of ordinary consumption.*

By only comparing investment options to the exclusion of other relevant choices faced by energy consumers, DSM biases its estimates of energy efficiency cost effectiveness. Although a Certificate of Deposits that earns an annual return of 10 percent might reasonably be said to be preferable to a CD that earns an 8 percent rate of return, the two options might be less desirable to a consumer than simply dining out at restaurants for two months, or donating the money to a charity. DSM theory fails to account for the non-monetary benefits of ordinary consumption.

Simply comparing the rates of return of various investment options also neglects the non-monetary cost components of investments, which often exceed the investment price of the asset significantly. These include transaction costs (the cost of obtaining information about investments, the cost of locating the investment, and the cost of completing the formalities of the exchange), measurement and evaluation costs (the cost of verifying the asset's income stream), the risks and uncertainties associated with the investment, its quality of service, and so on.

The deficiencies in cost-benefit estimates of energy efficiency investments, which omit significant cost components and are therefore systematically biased, suggest that the cost-effectiveness of energy efficiency improvements may be overestimated by DSM proponents, resolving the adoption paradox. DSM theory, however, attributes the paradox to a failure of energy markets, rather than inadequacies in its analysis.

**Other Immeasurable Costs**

Energy efficiency investments involve another category of cost that cannot be measured: quality-of-service losses sustained in the transition to more energy efficient technologies. Most energy efficiency improvements are accompanied by a qualitative alteration in the service provided by the technology, one that is potentially costly for the investor. Unfortunately, energy consumers that participate in DSM programs are seldom informed of this fact.

Interestingly, this calls into question the very notion that such technologies can be deemed energy efficient at all, let alone economically efficient. Energy efficiency is defined as the ratio of the useful energy provided by a dynamic system over the system's energy input. [A fuller account of this distinction is provided in the Appendix.] If the quality of service performed by a dynamic system is altered, it is impossible to discern changes in the level of "useful energy" provided by the system. Even if a technology consumes less energy than other alternatives, the difference in its quality of service may be such that the technology is actually less energy efficient.

*Most energy efficiency improvements are accompanied by a qualitative alteration in the service provided by the technology.*

All of the most common technologies employed in DSM programs are afflicted with quality problems. These include:

*Fluorescent lighting:*

According to DSM advocates, fluorescent bulbs provide the same illumination as incandescent bulbs at a lower price. However, fluorescent lighting poses significant quality problems that are often ignored in cost-benefit analyses.

Fluorescent bulbs are often less powerful than their incandescent counterparts, even when advertised by the manufacturer as equivalent. A *Consumer Reports* study of compact fluorescents found that "some manufacturers of fluorescent get carried away, exaggerating brightness claims on their bulb's package."[10] This included Panasonic's "60-watt" substitute for incandescents, which shed more than a third less light than the incandescent equivalent. Even Hunter Lovins, president of the adamantly pro-fluorescent Rocky Mountain Institute, told *Popular Science* magazine that she has difficulty reading by fluorescent light.[11]

Fluorescents have other quality problems as well. They emit light at a different wavelength than incandescents, which many consumers find annoying. Some bulbs exhibit "warm-up" periods between activation and illumination of up to two minutes.[12]

*Insulation*:

Reinforcing structural insulation in buildings and homes will mitigate heat losses and gains in winter and summer respectively. However, increased insulation typically reduces air infiltration from the outside (a major source of heat loss/gain), inevitably (1) lowering indoor air quality by trapping various emissions in the structure, and (2) increasing humidity levels.[13]

If utility customers respond to the quality loss by ventilating more, they may completely offset the energy-conservation of the increased insulation levels. Otherwise, the benefit of lower electricity bills may be offset by the cost in reduced indoor air quality. No studies have been done to determine if mechanical ventilation systems, which trap heat while ventilating buildings, use more electricity than they save.

*Increased insulation typically reduces air infiltration from the outside lowering indoor air quality by trapping various emissions in the structure, and increasing humidity levels.*

If customers turn their thermostat down during summer to compensate for the discomfort of increased humidity levels, they may use as much energy air conditioning their home as they did before the insulation improvement. Otherwise, they suffer the quality-of-life loss of the higher-humidity climate.

*Energy-Efficient Air Conditioners*:

Currently, energy-efficient air conditioners are required only to meet energy-efficiency standards without regard to alterations in the comfort of the living/working environment. Consequently, many "efficient" air conditioners (especially lower-cost ones) save energy by reducing the dehumidification function of the unit.[14] This must either result in reduced climate comfort, or (if the utility customer reacts by turning down the thermostat) an offsetting increase in running time for the air conditioner. In either case, the economic efficiency of the units are reduced or eliminated.

*Heat Pumps*:

Many DSM programs offer substantial rebates for heat pumps, which provide a less energy-consumptive alternative to conventional home heating and cooling systems. A heat pump is essentially an air conditioner that operates in reverse. During winter, the heat pump moves warmth from the cold outside air into the structure. In summer, the heat pump moves warmth from the cool structure to the outside.

Unfortunately, heat pumps can be uncomfortable during winter, because they maintain indoor heat levels by circulating only slightly warmer air within the structure. This significantly extends the length of time required by the pump to compensate for precipitous drops in outdoor temperature, or to heat an unheated home.[15] Such costs may outweigh the energy savings provided by the pump, making it less energy efficient than a gas or oil heater.

*Motion Sensors*:

Some DSM programs supply motion sensors for interior lighting in businesses. When the sensors detect motion in a room, they activate the lighting. If no further motion is detected within a set period, the lighting automatically shuts off. The nuisance effect is obvious. Unless the room occupant moves periodically, he will find himself in darkness. To compensate for this problem, some motion sensors can be switched off, leaving the occupant the responsibility of activating and deactivating the lighting, and disposing of the energy savings associated with the device.

*Energy Efficiency Training*:

Some programs train individuals to do such things as change the filters on their heating equipment, and wash fuller loads of laundry and dishes. These have obvious nuisance costs.

*The fact that energy market participants are not perfectly informed about all of their investment options is unfortunate, but it is indicative of the high costs of information transfer.*

**Market Failure vs. Analyst Failure**

The adoption paradox is resolved in DSM theory through the dubious theory of "market failure," which has suffered increasing criticism from economists in recent years.[16] According to this view, various defects in the operation of the market suppress adoption rates for energy efficiency measures and technology below optimal levels.[17]

One of the curious aspects of the theory is that it tacitly conceives of the market as a grand mechanism for the production and delivery of goods and services (one that has broken down), rather than a nexus of human interaction. If we understand the market in the latter sense, the idea is more clearly comprehended as a "human failure" theory. The "market failure" theorist is essentially diagnosing flaws in the behavior of his fellow men, behaviors he typically wishes to correct.

The failures attributed to the energy market by DSM proponents include: a lack of information about available technologies, the difficulty of measuring avoided costs, "split responsibility" problems and "artificially" low energy prices.[18] This view is epitomized by the Alliance to Save Energy, which asserts that

> The United States cannot afford to continue to indulge in the fantasy that the "invisible hand" will solve all our problems. Energy markets are not "free." Electric and gas utilities are regulated monopolies, world oil prices are at least partially controlled by OPEC; and the failure of markets to reflect environmental impacts is a textbook case of "externalities." In general, current energy markets bias private investment decisions toward energy production rather than energy efficiency and toward commercial energy-supply technologies at the expense of innovative renewable ones. Moreover, because they lack important

information, businesses and consumers often fail to take actions that are in their economic interest. Government policies can help to correct these various market imperfections.[19]

The market failure concept also implies that government can successfully intervene in the market to improve social welfare. This assumption is the subject of contentious disagreement among economists, and is disputed most notably by those of the Public Choice and Austrian schools.[20] Although the fact that market institutions regularly fail to facilitate perfect outcomes is undisputed, many economists doubt that government has the knowledge or incentives to improve upon them.

The "failures" commonly attributed to energy efficiency markets fall into three categories. The first represent transaction costs and measurement and evaluation costs that are unaccounted for in the price of the investments, and are therefore ignored in DSM cost-effectiveness estimates. Such factors better represent the inadequacies of DSM theory, than "market failures." The second category of instances constitute government failures, including inadequately-defined property rights and disagreeable regulatory practices. The third are merely normative assertions about the behavior of market participants dressed up as economic theory.[21]

*Information about energy efficiency investments is therefore quite heterogeneous — what is relevant for one person, family, or business is unlikely to be fully applicable to others.*

*Imperfect Information*:

The attainment of knowledge about the costs and benefits of energy efficiency investments is itself a cost component of those investments. Investors must commit time, money, and other scarce resources to gather such information, and sellers of such technologies must sustain costs in conveying it. The fact that energy market participants are not perfectly informed about all of their investment options is unfortunate, but it is indicative of the high costs of information transfer. Government intervention to "correct" this problem is therefore likely to divert resources from more economically-efficient uses.

Some, including Robert Stavins of Harvard's Kennedy school of government, contend that information about energy efficiency investments has the property of a "public good" — that is, a good that will not be supplied in optimal quantities by the mechanisms of the market.[22] Specifically, it is argued that because it is impossible to exclude others from using the information, many would-be suppliers of it will attempt to "free ride" on those who do supply it, resulting in a suboptimal level of information transfer.

Although it is probable that a "free rider" effect occurs in the process of transferring information about energy efficiency investments, it is unlikely to be significant. The profitability of such investments varies within a fairly wide range among individuals, given their unique living and working arrangements and end-use needs. Information about energy efficiency investments is therefore quite heterogeneous — what is relevant for one person, family, or business is unlikely to be fully applicable to others.

A substantial free rider effect would also require "fluid" or low-cost information transfer. In contrast to a hot stock tip, information concerning energy efficiency investments is often fairly complex and lacks fluidity. It should also be noted that information concerning the benefits of *many* products is arguably fluid in this sense, and therefore likely to generate widespread free-rider effects. Should government therefore institute a Bureau of Advertising to raise commercial information transfers to optimal levels?

*Avoided cost measurement*:

The measurement and evaluation of avoided cost savings attributable to energy efficiency measures may be costly, because their frequency of application can fluctuate quite widely, as well as that of other energy applications affecting the total energy consumption of the investor. Energy prices, which can also be quite volatile, must also enter the equation. Even if such effects can be isolated, the savings themselves will fluctuate over time, requiring meticulous and consistent observation, record-keeping, and computation.

*If investors avoid energy efficient technologies because of high measurement and evaluation costs, they are simply allocating their scarce resources efficiently.*

For example, the rate of return on a homeowner's investment in fluorescent lighting will depend on its frequency of utilization and the price of electricity over its lifetime. Measuring the actual savings by reference to monthly energy bills requires the homeowner to isolate the effects of his use of the lighting from his other uses of electricity. Such problems are not "market failures," but measurement and evaluation costs that consume resources, especially time. If investors avoid energy efficient technologies because of high measurement and evaluation costs, they are simply allocating their scarce resources efficiently.

*"Artificially" low energy prices*:

DSM proponents claim that energy prices often fail to reflect the "true" cost of energy use, for two principle reasons: 1) energy use often creates "negative externalities," such as atmospheric pollution, and "global warming," and 2) energy utilities often equate their rates with their average costs rather than marginal costs, thereby failing to reflect the "true" cost of production (see Appendix).

Although most health experts associate exposure to fossil fuel emissions with health risks, those risks are normally too low to represent a measurable externality, even according to the pessimistic calculations of the Environmental Protection Agency.[23] The "global warming" theory is considered unproven by most climate experts.[24] Moreover, both concerns could be addressed more directly and effectively by other measures.

Many energy utilities, contrary to the policy prescriptions of some economists, are not required to equate their rates with their marginal costs. However, this results from the failure of state Public Utility Commissions (PUCs) to regulate energy utilities accordingly. Again, expensive DSM programs are probably not cost-effective alternatives to marginal cost pricing.

*"Split Responsibility" Problems*:

Cases of "split responsibility" in the provision and economization of energy end-uses are often postulated as the cause of "failure" in energy efficiency markets. Common examples include landlord-tenant relationships.[25] Apartment buildings that pay electricity bills and then average the bills into tenant rental rates, it is argued, allow individual tenants to spread the cost of energy consumption among all tenants, creating a free rider effect that inflates their energy consumption above optimal levels and eliminates the incentive for tenants to invest in energy efficiency.

*If the purchasers of new homes and buildings value energy efficiency and are willing to assume the additional cost, building designers will profit by meeting that demand.*

The opposite arrangement is also said to discourage energy efficiency investments. Tenants who pay their energy bills individually are often short-term residents who have little incentive to make energy efficiency investments that pay off over the long run. The tenants' landlord in such arrangements has no incentive to invest in energy efficiency, because he doesn't sustain energy consumption costs.

Although both criticisms advance plausible explanations for low adoption rates, they do not indicate that those levels are economically inefficient, and therefore constitute market failures. They merely explain why energy-efficiency investments are not cost effective in certain situations. By criticizing the property relations prevailing in society for not fitting their preferences, DSM proponents move beyond the issue of economic efficiency and into a normative critique of society itself. Cost-effectiveness has no meaning in such a critique.[26]

More broadly, split-responsibility problems are said to pervade all energy end-use markets. Engineers and architects who design buildings are said to be more sensitive to the "upfront cost" of high energy-efficiency than the long-run benefit of lower energy bills for the building's users. A study for the Department of Energy by Oak Ridge National Laboratory even extends the phenomenon to used car markets, positing that used-car buyers encounter "imposed choices" with regard to the energy efficiency of their cars, because they had no influence over the decisions of new-car buyers years earlier.[27]

Such criticisms assume that building and car designers are not constrained by their customers' preferences. If the purchasers of new homes and buildings value energy efficiency and are willing to assume the additional cost, building designers will profit by meeting that demand.

Moreover, used car buyers influence the decisions of new car buyers through the resale market. Car manufacturers must satisfy their customers' desire to own an asset that maintains its value. If energy efficiency is cost-effective (that is, if the marginal cost of elevating a car's resale value is less than the marginal revenue generated by the improvement), then profit-seeking firms will produce accordingly. Representatives of the "split responsibility" view fail to explain why firms would neglect profit maximization with regard to energy efficiency.

*Normative "Failures:"*

Some purported "market failures" are normal market conditions that do not meet the approval of DSM proponents. Consumers and producers are said to be "biased" against energy efficiency. Or consumers have "inadequate access to capital" and therefore "high discount rates."[28] Such assertions, as persuasive and compelling as they may be, are purely normative statements about consumer preferences and the prevailing distribution of private property. As such, they merely represent the sentiments of the DSM proponent, and lie outside of the sphere of economic analysis.

## THE INEFFICIENCY OF DSM

> *If man is not to do more harm than good in his efforts to improve the social order, he will have to learn that in this, as in all other fields where essential complexity of an organized kind prevails, he cannot acquire the full knowledge which would make mastery of the events possible. . . .The recognition of the insuperable limits to his knowledge ought indeed to teach the student of society a lesson of humility which should guard him against becoming an accomplice in men's fatal striving to control society — a striving which makes him not only a tyrant over his fellows, but which may well make him the destroyer of a civilization which no brain has designed but which has grown from the free efforts of millions of individuals.*
>
> Friedrich Hayek[29]

*Some purported "market failures" are normal market conditions that do not meet the approval of DSM proponents.*

The purpose of DSM is to enable energy utilities to overcome the "adoption paradox," and correct the "market failures" that lead energy consumers to underinvest in energy efficiency. To do so, the energy utility must in effect replace the purportedly flawed judgement of the ratepayer with its own by investing in energy efficiency on the ratepayer's behalf. This requires a subtle but important redefinition of the utility itself.

In its traditional role as an energy seller, the utility's purpose is clear: to supply energy to municipal consumers at a profit, which is regulated to some extent by a state Public Utility Commission (PUC). Within the constraints set by the PUC, the utility seeks to maximize the present value of its future profits by selling an optimal quantity of energy.

*In its traditional role as an energy seller, the utility's purpose is clear: to supply energy to municipal consumers at a profit.*

DSM and Integrated Resource Planning programs broaden the purpose of the energy utility. No longer does the utility sell energy; it is reconceived as a purveyor of *energy end-use services*. It sells lighting, refrigeration, air conditioning and heating, television and radio service, and all other applications of energy. As a provider of energy end-uses, the utility no longer sees its energy supply operations as a source of revenue — rather, it conceives of energy supply as a cost of maintaining end-uses, just as its ratepayers do.

Within the new paradigm, the utility no longer seeks to maximize its energy sales. Instead, it undertakes what is known as Least Cost Planning (LCP), in which it compares "supply side" options for providing energy end-use services to "demand side" options. The cost of providing additional units of energy to customers (the supply side) is compared to the cost of improving the energy efficiency of customers, and thus lowering their rate of energy consumption (the demand side). If the demand-side option is less expensive, the utility invests in energy efficiency instead of energy production.[30]

For example, the utility may examine illumination as an end-use service to determine the least cost method of provision. The utility can continue to provide the energy for illumination through the incandescent bulbs commonly used by ratepayers, or it can subsidize the replacement of such bulbs with compact fluorescent lighting. If it costs $15 each year to illuminate a room with incandescents, and $13 with compact fluorescents provided through a DSM program, the utility will opt for latter.

Under the old utility paradigm, it is the role of the ratepayer to compare the cost of using energy to the cost of increasing his energy efficiency. The ratepayer examines the detailed and unique circumstances that confront him, accounts for the myriad of costs accompanying energy efficiency investments that are known only to him, and makes his decision. Within the DSM paradigm, the utility replaces the ratepayer as end-use consumer, and economizes on his behalf.

*DSM and Integrated Resource Planning programs broaden the purpose of the energy utility.*

Of course, energy utilities are incapable of providing energy end use services to their customers. In reality, the ratepayers provide themselves with end-uses by determining the composition and intensity of their demand. The utility's PUC is therefore required to simulate the proper conditions, to create an artificial world of incentives for the utility by altering the structure of its regulations. In this way, the utility experiences costs and benefits as if it really were an end-use provider.

To generate this economic form of virtual reality, the PUC merely allows the utility to recover the cost of its DSM program through the rates it charges,[31] just as it does for energy supply costs. The cost to the utility consists of two elements: 1) the cost of the DSM program itself, which includes the cost of the energy efficient technology (or the portion that is subsidized by the utility), the cost of installation (if any), advertising, administrative, and other costs, and 2) the revenue lost by the utility through diminished electricity sales. The utility is able to incorporate equipment costs into the rate base as "capital," and earn a return on its investment.

*Within the DSM paradigm, the utility replaces the ratepayer as end-use consumer, and economizes on his behalf.*

**Testing for Efficiency**

Measuring efficiency in a DSM planning process creates an unusual problem, which is best illustrated with an example. Let us say that, as in our earlier example, a ratepayer illuminates his room for $15 per year using incandescent light bulbs. The DSM planner estimates that the same end-use can be provided at $5 per year in energy costs with a more energy efficient compact fluorescent bulb that costs $8 more than the incandescent bulbs would have cost over the same period. It appears that the "demand side" solution is more cost effective: $10 in energy provision costs are saved for $8, for a net gain of $2.

Unfortunately, reality intrudes. The utility, after all, is really a seller of energy, not energy end-uses. It used to generate $15 in revenue from selling the energy, and now it generates only $5, for a net revenue loss of $10.[32] The total cost for the utility is therefore $18 — the $10 of revenue lost plus the $8 cost for the bulb and other related DSM expenditures. To save $10 in energy production costs, the utility pays $18, for a net loss of $8.

Is this efficient? In a free market, a firm that pursued such investments would soon be seeking protection from its creditors. But in the virtual reality world of DSM, the answer is yes.

According to DSM theory, the standard market test for efficiency should not be applied to DSM programs, which further the lofty goals of natural resource conservation and energy independence. Instead, a "Total Resource Cost (TRC)"[33] test (also known as an "All Ratepayer" or "Average Ratepayer" test) should be applied by state regulators. In lieu of comparing the revenues and costs of the utility, the TRC test compares the total cost of administering the DSM program (not including the revenue lost to the utility through lower energy sales) to the total avoided cost of producing the energy conserved. In other words, the TRC test simply ignores the revenue lost by the utility — treating it as a neutral "transfer" rather than a cost — while allowing it to be incorporated into the utility's rates as a cost.

*According to DSM theory, the standard market test for efficiency should not be applied to DSM programs*

In the above example, the TRC test only compares the $10 in avoided energy production costs (the benefit) to the $8 additional cost of installing a compact fluorescent light bulb (the cost), and pronounces the arrangement "efficient." Then, in order to provide "shareholder incentives" to entice the utility into making this "efficient" investment, the local PUC allows the utility to raise rates to make up for its $10 revenue loss, plus the $8 additional cost of the bulbs, for a total of $18. The ratepayers as a whole are therefore forced to pay $18 to benefit DSM ratepayer participants, who receive $10 in energy savings.

## The Hidden Tax

*Ratepayers who do not participate in DSM programs are forced to subsidize those who do.*

The upshot of this computational shell game is that ratepayers who do not participate in DSM programs are forced to subsidize those who do. All of the benefits from the utility's reduced energy supply costs are passed on to customers that participate in DSM programs, who purchase less energy, and therefore pay less. The cost of reducing the supply, however, is paid by all ratepayers equally, participants and nonparticipants alike. In essence, DSM simply functions as a hidden tax, transferring benefits from nonparticipants to participants.[34]

In recent hearings before the New York Public Service Commission,[35] several corporations in New York state offered horror stories about the net DSM surcharges they are forced to pay. These included the following examples:

- Camden Wire received $740 in DSM rebates from 1990 through 1992, but will incur $150,000 in DSM surcharges over a 12-month period.

- Blue Circle Cement's Ravenna plant will receive $100,000 in DSM benefits but must pay $683,000 in DSM surcharges.

- Bristol-Meyers' Squibb plant qualifies for less than $2,000 in DSM rebates, but will pay $700,000 over a 12-month period in DSM surcharges.

- General Motors' Inland Fisher Guide plant has received $3,415 in rebates from 1990 through 1992, but will pay $300,000 in DSM surcharges over a 12-month period.

- One Champion International facility qualifies for a $3,200 DSM rebate, but will pay $900,000 over a 12-month period.

*In essence, DSM simply functions as a hidden tax, transferring benefits from nonparticipants to participants.*

Some companies, such as Camden Wire, are perversely penalized for their commitment to energy efficiency. Because Camden Wire has already exploited most of the available cost-effective energy efficiency investments, it cannot take advantage of DSM subsidies. But it will be forced to subsidize competitors who neglected to invest in energy efficiency!

## Prices vs. Value

The TRC methodology strikes many electricity consumers as absurd and unjust,[36] but it is only the logical extension of the view that utilities are suppliers of electricity end-uses, rather than electricity. If this is in fact their function, then it is hardly appropriate for a utility to maximize the total profits generated by its electricity sales. Instead, the utility should minimize the costs experienced by its customers. The TRC test seeks to do just that.

The TRC test is essentially a utilitarian scheme. As such, it attempts to maximize the cost-benefit differential experienced by the whole body of ratepayers, while ignoring *who* sustains the costs and who receives the benefits — a dubious principle. But even granting utilitarian criteria, the TRC test confronts the external observer's ignorance of true costs and benefits, which are experienced by individuals subjectively.

*The TRC test is attempts to maximize the cost-benefit differential experienced by the whole body of ratepayers, while ignoring* who *sustains the costs and who receives the benefits.*

As a proxy for true costs and benefits, the TRC test substitutes money prices as measures of value. In fact, money prices represent *divergences* in value among individuals. If good *x* is exchanged for *y* dollars, one party must value good *x* more than *y* dollars, and another must value it less than *y* dollars. If the individuals both valued good *x* as much as *y* dollars, they would have no motivation to exchange one for the other, and the money price *y* would never emerge in the marketplace.[37]

Rather than measuring costs and benefits, money prices are merely one form of data that actors use to estimate those values individually. Because individuals value money differently, and because money prices do not account for foregone non-exchange opportunities, the prices cannot be used to compare the costs experienced by various individuals.[38] Prices represent the terms of exchange between two parties, and are therefore only properly understood as a means by which individuals coordinate their behavior with one another in the marketplace.

As economist Larry Ruff points out, a multitude of possible costs are associated with energy efficiency improvements that are not represented by money prices. The approach commonly used by DSM planners simply ignore this fact, and

> makes the common assumption that consumers experience no inconvenience, change in quality of service, or anything else that might impose direct costs or benefits on them as a result of the utility DSM program. There may be such situations: Perhaps the utility can sneak in at night and change the light bulbs and showerhead without the consumer ever noticing anything; or a utility rebate might allow a consumer to buy for the same price a high-efficiency refrigerator with the same capacity, external dimensions, color scheme, amenities, noise level, serviceability, etc, as the lower-efficiency refrigerator she would have bought otherwise. But cases in which DSM has no direct effect on consumers and hence imposes no costs or benefits directly on them are surely the exception rather than the rule.[39]

*"But cases in which DSM has no direct effect on consumers and hence imposes no costs or benefits directly on them are surely the exception rather than the rule."*

The TRC test is perhaps the least "scientific" aspect of DSM. The almost universally-recognized criterion for efficiency among economists is the "Paretian" standard, which requires that alterations in the distribution of resources make someone better off without reducing the well-being of anyone else. By subsidizing participating ratepayers at the expense of nonparticipants, TRC violates the Paretian criterion, and therefore disqualifies itself as a scientific test of efficiency.

## The Societal and Value Tests

A more expansive efficiency test in vogue among DSM advocates is the "Societal Test," which represents an even greater departure from economic reality. The Societal Test is an attempt to measure "aspects of demand-side management that affect the well being of society at large, not just the customers, program participants, or owners of a utility."[40] These include such ethereal values as "changes in air and water quality subsequent to changes in power plant operations, improvements in material security through decreased oil imports, and possibly, changes in public safety."[41]

The Societal Test requires DSM planners to compute money prices that correspond to various "externalities" allegedly generated by natural resource consumption and hence utility operation. Unfortunately, the test encounters the same problems inherent in the TRC approach: Money prices are no substitute for human values. The Societal Test, however, is even more problematic, because unlike the TRC test it must actually estimate "prices" that aren't generated by the market.[42]

Given the impossible requirements of the TRC and Societal tests,[43] economist Larry Ruff has remarked that

*"There is a name for a utility with the knowledge and control necessary to implement a DSM give-away program efficiently: God."*

> There is a name for a utility with the knowledge and control necessary to implement a DSM give-away program efficiently: God. Even to come reasonably close to the truly cost-effective result in any but the simplest cases requires a degree of knowledge and control that is unrealistic for any real-world situation.[44]

If utilities are indeed in a position to "play God," and manipulate their customers' end-uses consumption to achieve optimal results for "society," why stop there? Paul Joskow of MIT raises this question in a recent paper:

> If customers can't figure out when purchasing an efficient motor is in their self-interest, they probably have difficulty figuring out what the social cost minimizing fuel choice is when they choose between gas and electric heat or between gasoline, compressed natural gas, and electric vehicles. Well, we can put customer fuel choice options in our planning models and direct electric utilities to pay customers to use gas heat rather than electric heat when the models indicate that from a global societal cost minimization perspective many customers who are choosing electricity should really be choosing gas. Indeed, once overall cost minimization is the goal, and rate impacts are unimportant, there is no end to it.[45]

In recent months, utility consultants at Barakat & Chamberlin have proposed the "Value Test," in an attempt to compensate for the obvious deficiencies of the TRC and Societal tests. The Value Test builds on the TRC and

Societal tests by acknowledging end-use service quality effects associated with energy efficiency improvements, free rider effects, long-run rate impacts, and the effects of rate and cost changes on electricity consumption rates (the price and cost elasticities of end-use demand).[46]

The Value Test's main distinguishing characteristic and selling point is that it incorporates costs and benefits conferred by what it calls the "take back" effect. The take-back effect is simply the demand increase brought about by a price drop. Economists refer to this effect as the "demand curve." The Value Test includes the take-back effect in its cost-benefit computations by adding the increase in consumer surplus for DSM participants to the benefit side, and adding consumer surplus losses brought about by DSM-induced rate increases to the cost side.

The incorporation of so-called take-back effects into DSM efficiency test mixes apples with oranges. The TRC components of the test record resource prices as costs, and avoided costs as benefits, while the new "take-back" components treat consumer surplus fluctuations as costs and benefits. Given differing demand curve shapes, the same price change can cause different alterations in consumer surplus — monetary costs and consumer surplus changes are therefore not in any sense equal or analogous, and cannot reside in the same cost-benefit equation.

*DSM not only lowers utilities' total revenues, but also reduces their total profits over the long run by diminishing their volume of sales.*

While misapplying the obvious demand-curve effects of price changes, the Value Test fails to incorporate the same concept into its avoided cost computation. If the price elasticity of demand for a particular end-use is more than one (that is, it is price elastic in the strict sense), then the DSM investment will actually increase electricity consumption on net. This potential effect is ignored.

More fundamentally, the Value Test runs aground on its attempts to measure costs that are immeasurable, particularly those associated with the quality of end-use services. Costs and benefits are subjective, psychically-experienced phenomena that are not measurable by the external observer, and this is especially true in the case of quality of service, in which no observable exchange or money price emerges.

**Decoupling and ERAMs: The Ultimate Virtual Reality Scheme**

In recent years, utilities engaging in Demand-Side Management have become increasingly aware of the fact that DSM not only lowers their total revenues, but also reduces their total profits over the long run by diminishing their volume of sales. To compensate for this loss, DSM experts have concocted the ultimate form of virtual reality for energy utilities, one that completely severs their connection to the economic universe. Appropriately enough, it is called "decoupling."

Decoupling schemes seek to completely sever the association between utility revenues and electricity sales. Of course, if revenues are to be decoupled from sales, they must be recoupled to something else; enter the Electric Revenue Recovery Mechanism, or ERAM. An ERAM is a computational method used by the utility's PUC to ensure that the utility takes in a guaranteed level of revenue annually, regardless of its total sales or any other factors.

In completely decoupling utilities from their actual function of supplying energy to end-users, ERAMs are a dream come true for utility shareholders and executives, who find their incomes virtually guaranteed by the local PUC. ERAMs also benefit the PUC commissioners themselves, who find that regulation is facilitated by the "regularity" provided by the mechanism. The benefits of ERAMs to utilities and PUCs are asserted with admirable frankness by John H. Chamberlin, a utility consultant who has pioneered decoupling and ERAMs:

> Decoupling is...intended to provide a more stable financial environment. Decoupling, with a year-to-year adjustment for growth in the cost of service, can serve both customer and utility interests. With decoupling, earnings do not depend on whether the utility is having a "good" or "bad" year, weather-wise or economy-wise. Instead, earnings are much more likely to be in line with the Commission's expectations, as established in the most recent rate case. This greater stability allows rate cases to be put on a longer and more regular cycle, reducing the administrative burdens and costs of regulation.[47]

*By guaranteeing the utility's annual revenue, the PUC allows the utility to profit from the economizing behavior of its own customers, whether or not their lower level of energy use is brought about by a utility DSM program.*

In typical decoupling schemes, the revenues of the utility are recoupled to some sort of index, such as the Consumer Price Index, or the size of the ratepayer population. The PUC then guarantees that the utility's revenue will rise or fall each year in proportion to the index. If the utility's revenues are recoupled to the Consumer Price Index, for example, and the CPI rises by 10 percent over a given time period, the utility's revenues will rise by 10 percent. If the utility's revenues fall short of the level guaranteed by the ERAM, it is allowed to raise its rates in the next year to recover the lost revenue.

By guaranteeing the utility's annual revenue, the PUC allows the utility to profit from the economizing behavior of its own customers, whether or not their lower level of energy use is brought about by a utility DSM program. If ratepayers reduce their energy use by improving their energy efficiency without DSM incentives, or simply diminish their level of end-use (by remembering to turn off lights more often, for example), the utility will be able to recover its lost revenue through the ERAM, which will raise rates to compensate. The more ratepayers economize and reduce their energy consumption, with or without the utility's prodding, the more their rates will increase. The ERAM therefore penalizes ratepayers for using less energy, and allows the utility to profit from their thrift!

**Will DSM Eventually Require Tax Subsidies?**

Regulatory mechanisms that raise utility rates to subsidize DSM programs may ultimately require infusions of tax revenues to remain financially viable. This is evident from the fact that rate increases boost total profits over a limited range;

at some level (assuming demand doesn't grow with sufficient rapidity), marginal cost just equals marginal revenue, and lower total profits result from any price increases. At that point, DSM surcharges will only be available through the tax system.

How soon the profit maximizing rate is reached is determined by a number of factors, including the rate of demand growth or shrinkage for energy end-uses in the utility's market, the slope of the demand curve, and the level of the utility's annual investment in DSM. Utilities serving growing markets may never reach profit-maximization. Those serving stable or shrinking markets will face this dead end sooner or later.

**A "No Losers" Test?**

The first Demand-Side Management programs (those of the late 1970s and early 1980s) didn't apply Total Resource Cost or Societal tests of efficiency. Instead, they applied a "no losers" test designed to allow only DSM investments that didn't force nonparticipants to subsidize participants by paying higher rates.

*Regulatory mechanisms that raise utility rates to subsidize DSM programs may ultimately require infusions of tax revenues to remain financially viable.*

This test, variously known as a "Rate Impact Measure (RIM) test," "nonparticipant test, and "Impact on Rate Level (IRL)" test, simply asks if the DSM program elevates or reduces the rates of non-participating ratepayers. Those DSM projects that fail the RIM test and elevate rates are discarded. RIM tests were largely abandoned in the early 1980s when they appeared "too restrictive" to DSM proponents.[48] Today, few if any utility DSM programs pass the RIM test, forcing nonparticipating ratepayers to subsidize DSM participants.[49]

In my analysis of the TRC test, I assumed that the utility's cost per unit of output is equal to the price. However, cases can occur in which costs rise above price. From day to day and year to year, demand fluctuates for utility energy services, causing marginal costs to spike and temporarily exceed price. Marginal costs can also exceed price over the long run if market demand growth necessitates the construction of new capacity. In such cases, DSM programs can in theory lower the rates of nonparticipants and pass the RIM test.

Let us say, as in our earlier example, that a ratepayer illuminates a room at \$15 per year using incandescent bulbs. The utility and its PUC know that the population in the customer area will rise precipitously over the next few years, requiring new plant construction and driving the cost of providing the illumination to the ratepayer with incandescent bulbs to \$20 per year. If, however, the ratepayer installs a compact fluorescent bulb (which uses half the energy over the same time period), the price will be only \$10.

If the utility spends \$2 to induce the ratepayer to install the compact fluorescent bulb, it will save \$10 in energy production costs (for simplicity's sake, revenues are assumed to equal costs). This is, of course, efficient from the TRC perspective. But because the revenue lost to the utility is only \$5, the total cost to the utility is only $7. The utility reduces its production costs by $10, for only $7 in DSM costs and lost revenue. Rates can therefore fall to cover the utility's lower total cost, which has been reduced by $3. All ratepayers benefit, including nonparticipants.

Clearly the RIM test is unobjectionable from the ratepayer's standpoint. The test assumes, however, that the utility knows how much its DSM expenditures really affect demand, a dubious assumption explored in the following chapter.

## THE COST OF A NEGAWATT: ACCOUNTING FOR DSM PERFORMANCE

*The first Demand-Side Management programs applied a "no losers" test designed to allow only DSM investments that didn't force non-participants to subsidize participants by paying higher rates.*

If the card house of DSM rests on dubious tests of efficiency, then its teetering pinnacle is the Measurement and Evaluation (M&E) of DSM program performance. Many, if not most DSM programs simply ignore the difficult issues raised by M&E, and thus operate on wildly-inflated estimates of DSM's cost-effectiveness.

Most DSM programs estimate the cost savings of energy efficient technologies by making engineering estimates of the lower level of energy consumption generated by energy-efficient end-use technologies. Such calculations use standardized assumptions about the frequency of utilization of energy end-use services, and combine them with the estimated energy efficiency of the technology in question. Unfortunately, such estimates normally fail the impossible requirements enumerated below and therefore ignore substantial program costs, including "free rider" effects, administrative costs, and advertising costs. They also tend to ignore income and substitution effects between various energy end-uses. As a result, energy utilities may significantly overestimate the efficiency of their DSM programs.

### The Seven Impossible Feats

To estimate the true effectiveness of a DSM program, even according to the criterion of the RIM test, the utility must, in Herculean fashion, accomplish at least four, and as many as seven, impossible feats. For any test, the utility must:

1) distinguish between DSM program participants who were induced to adopt energy efficient technologies through program incentives and

participants who would have invested in the technologies without the program, but are participating to take advantage of the subsidies and other benefits (free riders),

2) determine how the price of an end-use is related to the demand for the end-use (the end-use's elasticity of demand, or the "take-back effect" of end-use price changes),

3) determine how the price of each utility energy end-use affects the ratepayer's demand for all other utility energy end-uses (the end-uses' cross-elasticities of demand, or the "interaction effects" of end-use price changes), and

4) identify all the individuals who are delaying investments in energy efficiency in anticipation of a future DSM subsidy program (strategic investors).

*DSM programs operate on wildly-inflated estimates of DSM's cost-effectiveness.*

If the TRC or Societal test is applied, the utility must also:

5) compute all of the costs and benefits subjectively experienced by DSM participants as a result of their involvement in the program.

Finally, if the Societal Test is applied, the utility must also:

6) determine the cross-elasticities of demand for each utility energy end-use and all other goods that generate negative externalities, and

7) compute all of the subjectively experienced costs and benefits experienced by society as a whole as a result of the DSM program.

All seven tasks necessary for an accurate measurement and evaluation of a DSM program performance require the DSM planner to penetrate the minds of ratepayers, and determine their motivations and preferences, a feat more difficult than all the labors of Hercules combined.

In addition, M&E requires a cost analysis of several factors that are observable, but are often ignored. These include:

*To estimate the true effectiveness of a DSM program, the utility must, in Herculean fashion, accomplish at least four, and as many as seven, impossible feats.*

1) identification of those ratepayers who quietly become nonparticipants after initially participating in a DSM program — for example, those who are dissatisfied with compact fluorescents installed through a DSM program, and remove them without notifying DSM program evaluators (the rate of Post-Participation Rejection [PPR]),

2) identification of cases in which the DSM subsidies induce investors to eschew more energy-efficient technologies in favor of those included in the DSM program, and

3) other costs, such as administrative, advertising and installation costs.

**Free Riders and Free Drivers**

The "free rider" effect is a major cost-booster for DSM programs. Free riders are DSM program participants who would have invested in energy efficiency in the absence of the DSM program. Free Riders increase DSM administrative and subsidy costs without increasing energy efficiency.

*Free Riders increase DSM administrative and subsidy costs without increasing energy efficiency.*

In their engineering estimates of DSM cost effectiveness, many programs fail to account for free riders, despite their potentially substantial impact on program costs. Virginia Kreitler of Synegetic Resources Company has conducted the most extensive survey of free-rider estimates in the U.S. She found that residential appliance programs contained 63.3 percent free riders on average, and commercial programs contained 37.7 percent free riders.[50] More recent surveys have found free-rider rates ranging from 6 to 95 percent for various DSM programs.[51]

Unfortunately, it is impossible to assess free-rider effects with anything approaching full accuracy. The most accurate means available to the utility are the use of small-scale ratepayer telephone surveys that ask DSM participants if they would have invested in energy efficiency in the absence of the utility program.

The question is purely hypothetical, and fundamentally unanswerable. Individuals are incapable of knowing precisely what they would have done under different circumstances. After participating in the program, the customer has the benefit of hindsight, and judges his decision on the basis of his existing knowledge about the investment. A customer who mistrusted compact fluorescents before accepting them in a DSM giveaway program might in retrospect believe he would have adopted the technology (or, if dissatisfied, might believe the opposite).[52]

To the extent that such surveys are answered accurately, they only reveal those who were induced to participate in the DSM program *at the moment they made the decision to do so.* They cannot account for those who would have invested in them a month or a year later, and who therefore become free riders at some point after they begin to participate in the DSM program.

*Unfortunately, it is impossible to assess free-rider effects with anything approaching full accuracy.*

To counter "free rider" objections, DSM proponents have introduced the notion of "free drivers" — DSM nonparticipants who are induced to invest in energy efficiency by the utility DSM program. To this author's knowledge, no estimates have been made of free driver effects, but as Albert Nichols of National Economic Research Associates (NERA) observes, if there are significant free driver effects, it raises serious questions about the wisdom of the rebate programs that dominate most DSM efforts. If firms or households install eligible measures but do not collect the rebate, that suggests that the transactions costs associated with participating in the program are significant; if that is true, net benefits may be much lower than our estimates suggest. Moreover if many people adopt the measure simply because of the publicity, that raises doubts about the need to offer subsidies.[53]

Epistemically, free driver estimates confront the same problems as free rider estimates. It is impossible to penetrate the consciousness of ratepayers and determine their motivations in making particular decisions.

**Demand Elasticities and Subjectively Experienced Costs**

Like free rider effects, the estimation of demand elasticities (necessitated by the third, fourth, and seventh impossible feats) requires knowledge of the subjective valuations of individuals. Responses to price fluctuations are determined by the consumers' valuation of money and the good or goods in question.

Economists sometimes attempt to estimate the demand elasticities of various goods by using statistical estimation techniques. They compare the prices of goods to the quantity purchased in different periods, and endeavor to discover their relationships through "regression" techniques. These methods, however, suffer from two irreparable flaws.

First, it is impossible to hold the preferences of individuals constant during the period of measurement. A shift in the demand curve therefore cannot be distinguished from a purely price-induced change in quantity demanded. Second, even if preferences were stable during the period of measurement, only the shape of the market demand curve at some period in the past would be indicated. Prices and quantities demanded are only revealed *ex post*. A statistically-derived demand elasticity can at best represent past conditions, not future conditions.[54]

*It is quite possible that increasing a ratepayer's energy efficiency will actually increase his total level of energy consumption.*

Without knowing the relationships between ratepayers' demand for various energy end-uses and the prices of those end-uses, the DSM planner cannot predict the effect that an increase in energy efficiency (and therefore a decrease in the price of an end-use or uses) will have on the ratepayer's total demand for energy. Not only might DSM programs have a less-than-estimated impact on utility energy demand, but it is quite possible that increasing a ratepayer's energy efficiency will actually increase his total level of energy consumption.[55]

The sixth and seventh impossible tasks require the DSM planner to directly measure the costs and benefits experienced by individuals in the form of externalities, and quantify them as money prices. As the previous section of this paper observes, money prices don't represent cost and benefits; they are only data through which individuals derive a partial estimate of the costs and benefits they will sustain in a given exchange. In any case, subjective forms of valuation are unknowable by the planner.

**Strategic Investors**

How many individuals delay their plans to invest in energy efficiency on the hope that they will receive DSM subsidies for those investments in the future? Utilities, of course, have no way to discover this, short of eminently fallible surveys.

Commercial and Industrial ratepayers are even more likely than residential ratepayers to delay such investments. Not only do they face the prospect of losing a substantial subsidy from the utility, but also the possibility of subsidizing their competitors' energy efficiency improvements through DSM rate increases.

## Ignored Costs

Engineering estimates frequently ignore cost factors that are in fact measurable. These include the rate of Post Participation Rejection, as well as administrative, advertising, and installation costs.

*Engineering estimates of DSM effectiveness typically ignore costs that are easily measurable by the utility, including administrative, marketing, and M&E costs themselves.*

To this writer's knowledge, no utility DSM program estimates the rate of Post-Participation Rejection (PPR) for its energy efficiency subsidies. It is certainly conceivable that individuals who, for example, have their incandescent bulbs replaced with compact fluorescents, might be dissatisfied, and remove the fluorescent bulbs after a brief period of use. How often does this occur?

A recent study of utility DSM programs by Paul Joskow and Donald Marron of MIT revealed that engineering estimates of DSM effectiveness typically ignore costs that are easily measurable by the utility, including administrative, marketing, and M&E costs themselves. Often, utilities simply rely on the engineering estimates made in "Technical Potential" analyses conducted by such organizations as Amory Lovins' Rocky Mountain Institute (RMI) and the Electric Power Research Institute (EPRI). As Joskow and Marron observe, "[DSM] program costs often include at least some administrative costs — for example, overhead, program monitoring and evaluation, marketing, and administration — that are either ignored (RMI) or understated (EPRI)."[56]

Joskow and Marron found that while RMI assesses the cost of a 75 percent increase in energy efficiency at 0.6 cent per kilowatt-hour saved, and EPRI estimates that a 30 percent efficiency increase can be effected at a cost of 2.6 cents per kwh saved, the actual cost is probably much higher. Their survey of DSM programs revealed an average cost of 3.4 cents per kilowatt-hour, 30 percent higher than the EPRI estimate and nearly 500 percent higher than the RMI estimate. They conclude that

> our research indicates that it is a grave error for policy-makers to think about conservation from the perspective of the perfectly-informed central planner. They should not assume that the utility and its regulators can identify cost-effective opportunities for millions of customers from a crude engineering and economic model and then use subsidies to induce those customers, at minimal transaction costs, to undertake only cost-effective conservation opportunities.[57]

## Engineering Estimates vs. Impact Evaluations

While the engineering estimates employed by DSM planners typically use standardized assumptions that ignore free riders and other costs, some programs conduct "Impact Evaluations," to detect DSM-induced alterations in the total level of demand for utility services.

Impact evaluations suffer from the same deficiencies as regression analyses of demand elasticity. They are incapable of holding factors other than the DSM program constant, and may therefore mistake non-DSM induced effects for demand reductions brought about by DSM. Further, they must posit a baseline estimation of future demand that requires a forecast of future utility energy demand and therefore future ratepayer preferences.

The dubious reliability of both impact evaluations and engineering estimates is indicated by the wildly differing estimates of energy efficiency they produce. A study by Steven Nadel of the American Council for an Energy Efficient Economy and Ken Keating of the Bonneville Power Administration of 37 DSM program evaluations that measured energy savings with both engineering estimates and impact evaluations found that the DSM programs studied achieved only 48 to 57 percent of the energy savings promised by engineering estimates.[58] In some cases, the programs achieved less than zero percent savings — that is, they actually increased energy usage on net.[59]

*Impact evaluations suffer from the same deficiencies as regression analyses of demand elasticity. They are incapable of holding factors other than the DSM program constant.*

Other, more recent comparisons between impact evaluations and engineering estimates have found similar discrepancies. A study for the New Jersey Conservation Analysis Team recently found an 83 percent impact evaluation to engineering estimate ratio.[60] Another by Massachusetts Electric Company (MECO) found an average ratio of between 53 and 66 percent.[61]

**Exacerbating the AJW Effect**

In addition to the unfortunate epistemological problems confronting the M&E of DSM programs, M&E creates new opportunities for utilities to drive up their costs in order to boost their profits, an incentive they already have under conventional regulatory schemes.

PUCs typically allow energy utilities to earn a certain rate of return on their annual investment, which is measured by the rate base. As a result, utilities face a perverse incentive — the greater their costs, the greater their profits. They can therefore profit by inflating their capital costs and convincing the PUC to incorporate them into the rate base. This is known among economists as the "AJW effect," named after Averch, Johnson, and Wellisz, three economists who advanced the theory in late 1962 and early 1963.[62]

Under normal conditions, a utility may find any number of ways to unnecessarily inflate its rate base — a salient possibility is the maintenance of more standby generating capacity than is warranted. But under the old utility paradigm, regulators do have a signal that costs are out of hand: the rate level. If a utility finds it necessary to increase its rates in order to cover its rate base, it may be incurring unnecessary capital costs.

Under DSM schemes that use such efficiency measures as the TRC test and the Societal test, rate levels no longer indicate cost-effectiveness. Instead, efficiency can only be discerned through the hazy and easily-distorted lens of various M&E methods. It is a simple matter to make false assumptions in DSM M&E, because the assumptions by their very nature can't be verified.

A utility that uses impact evaluations to estimate the influence of their DSM investments on demand must assume that demand levels in the absence of the DSM program will be close to some sort of baseline; but determining the baseline requires the planner to predict the future preferences of utility customers. As Paula Rosput of Pacific Gas and Electric observes, "There is one thing that can be said for certain about these forecasts — they will be wrong."[63]

*Utilities face a perverse incentive — the greater their costs, the greater their profits.*

Unfortunately, in a DSM process the utility's forecasting errors are obscured by the influence of its DSM efforts, which render distinctions between baseline and DSM-influenced demand fluctuations impossible. Unlike conventional demand forecasting, which seeks merely to project future demand to assess future capacity requirements, DSM forecasts are by their nature unverifiable, and therefore more susceptible to manipulation.

Through the TRC and Societal tests of efficiency, DSM planners will find it very profitable to make inflated estimates of future demand growth, to underestimate the price-elasticity and cross-elasticities of demand for energy end-uses, and so on. Because unverifiable assumptions are necessary for such estimates, the PUC will have little objective basis on which to dispute them. Conversely, utility ratepayers have every incentive to properly judge the cost-effectiveness of an energy efficiency investment, because their own economic well-being is at stake.

## UNDERSTANDING DSM: A PUBLIC CHOICE PERSPECTIVE

*[UTILITY] EXEC[UTIVE]: Pst, would you like some DSM?*
*REGULATOR: Is that the stuff those pesty environmentalists and my governor want me to try?*
*EXEC: The very same.*
*REGULATOR: Is it expensive?*
*EXEC: I don't know, but neither does or will anyone else. Besides, it won't cost you a dime.*
*REGULATOR: What's in it for you?*
*EXEC: I get to recover my costs, plus a modest profit that no one will ever be able to compute, plus I get great PR and, with luck, the Amory Lovins award for creative construction of statistical and cost data.*
*REGULATOR: What's in it for me?*
*EXEC: Quite possibly dinner with Al Gore and a special award if you stay awake during his greeting.*
*REGULATOR: Will we get caught?*

*EXEC: Not a chance. Some fringe group of industrial customers will try to expose us, but they are interested in profit-making and therefore have no credibility in regulatory or political circles.*
*REGULATOR: Ok, let's give it a try.*

Irwin Stelzer
American Enterprise Institute[64]

The impossibility of Demand-Side Management raises an important question: why, given its glaring flaws, is it being attempted on such a grand scale? The answer may be found in the incentive structure inhabited by the utilities, their larger commercial and industrial customers, their PUCs, purveyors of energy efficient technologies, environmental activists, and other DSM proponents.

This alternate approach to understanding DSM is known by economists as a form of "Public Choice" analysis. Public Choice economics examines the incentives faced by individuals interacting within the public sphere, where governmental and quasi-governmental institutions exercise a coercive influence over individuals, firms, and one another within a constitutional and legal framework. Institutions and individuals are assumed to follow to the same incentives that motivate them in the marketplace: politically-secured monetary profits (often referred to as "rents"), career advancement, prestige, power, etc. From this perspective DSM appears not as a good-faith attempt to maximize social welfare, but as a form of rent-seeking — an attempt by certain groups to rationalize their use of energy utilities and PUCs to extract rents from others.

*DSM is a mixture of benign intentions, intellectual error, and self-interested duplicity.*

Certainly, DSM cannot be dismissed simply as a rent-seeking scheme. It is more likely a mixture of benign intentions, intellectual error, and self-interested duplicity.[65] The purpose of Public Choice analysis is to construct a model that accounts only for the latter element, and examine its efficacy in predicting and explaining the behavior of DSM proponents. We might thus learn the extent to which DSM is in fact a rent-seeking scheme.

**The Rent-Seekers**

The first public choice analysis of DSM was published by Douglas Houston in a paper for the Institute for Energy Research.[66] Barnard Black and Richard Pierce, Jr., of Columbia University, have also contributed to this line of inquiry.[67] Houston identifies three primary DSM racketeers that form a "nexus of interests": public utility commissions, environmentalists, and utilities. To these, I add: certain large industrial/commercial utility customers, and the producers of energy efficient technologies. Minor players also include consultants and economists who are threatened with disemployment due to the declining fortunes of central planning ideology, and therefore seek to establish and maintain new territories for themselves.

How do DSM rent-seekers stand to benefit? An examination of each follows.

*Energy Utilities*:

Houston observes that "according to the rent-seeking hypothesis, utilities' attraction to DSM was not caused by a sudden recognition that DSM programs could fulfill missed opportunities to conserve energy or to deal with pollution externalities, but rather was a function of the utilities self interest in improving their financial condition."

*"DSM was not caused by a sudden recognition that DSM programs could fulfill missed opportunities to conserve energy or to deal with pollution externalities, but rather was a function of the utilities self interest in improving their financial condition."*

As explored in the previous section, utilities can easily exploit the subjectivity of M&E calculations to inflate their estimates of the cost-effectiveness of DSM, without the political constraints imposed by substantial rate increases. Houston observes that utilities may also find in DSM a convenient way to exclude their customers from the new and growing retail energy markets that threaten to shatter the old regulated-monopoly system that guarantees their profits (examined in the next section).[68] If the utility manages to wrangle an ERAM out of the PUC, it can guarantee its revenues indefinitely, and profit from its own customers' thrift (see above). All the while, the utility can boost its corporate image as an "environmentally sensitive" firm.[69]

*Public Utility Commissions*:

PUCs have two primary incentives to allow utilities to conduct DSM programs. First, as Houston observes, PUCs typically cater to the demands of the most well-organized and well-funded interest groups, rather than the vast body of ratepayers. While the cost of DSM is spread thinly among the ratepaying public, its benefits are concentrated in a few groups, which are therefore willing to invest substantial resources to influence PUCs.[70]

Houston also notes that as a new national consensus builds in favor of deregulating municipal electricity provision, PUCs may find DSM attractive for the same reason the monopoly utility does: it necessitates the continuation of regulation, thus rationalizing and preserving the existence of the PUC itself.[71] This point was raised recently by Jim Clarkson and Allison Wade of Southwire Corporation in a brief submitted to the Georgia PUC:

> This commission, too, has stated that its main reason for existing was to protect consumers from high power bills through redistribution of wealth. Thus far in these proceedings the Commission has ignored the consumer interest in lower bills and favored the interests of the regulatory establishment in defending and enhancing its political pelf. With the rapid development of competition bringing many consumer benefits, the Commission sees itself as becoming irrelevant and obsolete, and rightly so. Demand-Side

management is a desperate effort by the commission to establish itself as a "useful" and "important" organ of government.[72]

Third, because DSM programs allow utilities to raise rates, a PUC can easily hide its failure to rigorously monitor the efficiency of the firm by accepting biased estimates of DSM cost-performance from the utility. While allowing the utility to distort the cost-effectiveness of its investments, DSM allows the PUC to distort its own performance, making it less accountable to those who appoint them, and ultimately to the public at large.

*Environmental Groups*:

Environmental groups see DSM as a way to connect the economic interest of utilities to the realization of their own ideological goals, which include a dramatic reduction in fossil fuel consumption and the consequent pollution. Moreover, DSM allows environmentalist groups to hide the cost of their political goals from their contributors. Simply restricting fossil fuel consumption at the point of end-use or levying a formal tax might be politically inviable; DSM allows the expenditures to take the form of a hidden tax in the rates of nonparticipating utility customers, who often are unaware of the existence of DSM, let alone its impact on their incomes.

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*Large Commercial/Industrial Utility Customers*:

As Houston observes, DSM's biggest opponent is ELCON, the association of the largest electricity consumers in the U.S.. Nevertheless, some large commercial and industrial customers are avid supporters of DSM, and their motivation is clear: They are subsidized through DSM rebate programs, which allow them to invest in energy efficiency at the ratepayer's expense.

*Producers of Energy Efficient Technologies*:

Companies that produce high-efficiency HVAC systems, fluorescent light bulbs, and other DSM-subsidized equipment benefit enormously from the inflated demand for their products, and thus are natural supporters of DSM and other programs which serve to subsidize their industry.

*DSM Theorists, Consultants, and Planners*:

A number of economists and utility consultants have made a cottage industry of DSM planning, constructing sophisticated mathematical models for DSM M&E purposes, and testifying before PUCs on behalf of utilities. Understanding DSM proponents in this way can inform an analysis of the "market failure" theories they advance. The DSM planner has a strong incentive to misjudge the economic efficiency of various end-use technologies, while the participants themselves have a strong incentive to make accurate estimates.

## RETAIL WHEELING: THE GREAT ENEMY OF DSM

In recent years a trend directly in opposition to the central planning philosophy of DSM has gained momentum. For decades, utilities have become increasingly reliant on the wholesale electricity market to maintain service during periods of high demand. The wholesale electricity system, unlike the retail system, is a relatively competitive market. Utilities can purchase their power from hundreds of other providers linked to a common regional transmission grid. The process of sending and receiving power through the grid is known as "wholesale wheeling."

The 1980s saw an expansion of this system, as utilities began to make long-term wholesale purchases from Independent Power Producers and utilities, in lieu of building new plants. Now, industrial power consumers are demanding access to the wholesale system, allowing them to bypass the monopoly utility and gain the benefits of open competition. The process is known as "retail wheeling," and it would mean the end of the monopoly utility system. It would also render most Demand-Side Management programs impossible.[73]

*The wholesale electricity system, unlike the retail system, is a relatively competitive market.*

### A Bit of History

Since the 1920s, utilities have traded electricity among themselves over increasingly interconnected regional transmission networks. Such trading relation ships began as a means to maintain the reliability of service provided by each utility; if a utility was overwhelmed by unforeseen levels of electricity demand, it could purchase power from members of its local "power pool."[74]

In recent years, a series of unforeseen events have brought about a revolutionary change in wholesale electricity provision. Acting on the assumption that demand for electricity would grow and economies of scale would continue to obtain as they had for decades, many utilities overinvested in new generating capacity, especially nuclear reactors. The economies of scale failed to materialize, however, operating costs increased, and demand flattened out. Many utilities were forced to raise their rates substantially to remunerate themselves for their malinvestments; some were not allowed to do so, and suffered significant losses.[75]

The overexpansion fiasco of the 1970s led to a deeply conservative attitude in the industry during the 1980s.[76] Utilities were no longer eager to invest in new capacity; they were more inclined to satisfy their customers' electricity needs through low-risk investments. These included DSM projects, which represented more short-term, incremental commitments than large power plants.

Wholesale electricity purchases also increased in popularity. A wholesale electricity market has long existed among major utilities, which "wheel" electricity to one another over sprawling transmission grids, subject to price regulation by the Federal Energy Regulatory Commission (FERC). But in the early 1980s, the market received a boost from an unlikely source: the Public Utility Regulatory Policy Act (PURPA) of 1978.[77]

In seeking to promote alternative energy sources, PURPA mandated that electricity utilities purchase power from companies using "alternative" generation methods (especially cogeneration), at the utility's avoided cost. Although its purpose was merely to provide a subsidy to "politically correct" sources of energy, PURPA spawned a new industry of small, wholesale power producers. Initially high avoided cost estimates by PUCs led to an uncompetitive market, but many PUCs eventually reevaluated their estimates, and many now use a competitive bidding process to establish them. The utilities, loath to invest in risky new power plant projects, have grown increasingly reliant on wholesale power producers.[78]

Soon, large-scale commercial and industrial power consumers were asking: why stop with "wholesale wheeling"?[79] Why not extend the wheeling process to the retail market, allowing customers to select their electricity providers? Why indeed. Although electricity utilities do not present a monolithic view on the issue, they are largely opposed to "retail wheeling," and with good reason: Their costs often exceed the average rate of 6 cents per kilowatt-hour (some as high as 16 cents),[80] rendering many of them uncompetitive. State public utility regulators also have a vested interest in preserving the current system; they would probably be the first casualty in a free electricity market.

*In its current form, DSM would be impossible without the monopoly power of the utility.*

Retail wheeling arrangements, if made available to every electricity consumer, would mean the end of the electric utility system as it is known today in the United States. Electricity consumers would be able to choose their suppliers from among hundreds of utilities and independent power producers linked to the national grids. Rate regulation could be largely eliminated in favor of competitive pricing.

**DSM vs. Competition**

In its current form, DSM would be impossible without the monopoly power of the utility, which allows it to raise rates and cross-subsidize DSM program participants. In a free electricity market, a utility that attempted to raise its rates would rapidly lose its customers to a competitor. Even DSM investments that passed the RIM test would be infeasible, because power companies would lack a stable customer base from which to realize long-run cost avoidance.

Moreover, most wheeling arrangements would consist of single, "block" sales of power, rather than moment to moment satisfaction of fluctuating demand. Maintaining required voltage levels on a distribution grid in the face of fluctuating consumption requires the local generator to reactively increment or decrement generation, a process known as load matching. This would most likely be provided by the local utility. In many cases the primary electricity seller would experience no peaks or valleys in customer demand, and would have little economic incentive to influence it.

Cross-subsidized DSM programs and retail competition are mutually exclusive. Supporters of DSM, therefore, tend to oppose retail wheeling, which would eliminate or reduce the scope of the utility monopoly system and incapacitate DSM programs. Utilities, PUCs, and others with a vested interest in the current regime may therefore find that DSM is their ultimate defense against retail wheeling.

Utilities and PUCs have a strong incentive to oppose retail competition. Many utilities produce electricity at a per-unit cost exceeding competitive rates significantly, and would be unable to compete in an open market. A number of investment houses have recognized this fact, and have already begun to reevaluate utilities according to a "competitiveness risk index." [81]

Some environmental groups, such as the Natural Resources Defense Council, want to preserve DSM as a convenient source of revenue for energy efficiency subsidies. In the absence of DSM programs, groups like NRDC will be forced to lobby for formal tax subsidies, and are likely to confront significant political resistance. Recognizing the threat posed to existing DSM programs by retail wheeling, NRDC and other environmental groups have joined to oppose electricity deregulation.[82]

*Recognizing the threat posed to existing DSM programs by retail wheeling, NRDC and other environmental groups have joined to oppose electricity deregulation.*

**Is Integrated Resource Planning DSM's Worst Enemy?**

Despite existing barriers to full competition among electricity providers, the wholesale market continues to become more competitive. Under the Energy Policy Act of 1992, utilities must provide wheeling services to IPPs, which makes more extensive wheeling arrangements possible, and expands the options of wholesale buyers. As the number of IPPs grows, this requirement will become more significant; IPPs are expected to satisfy half of new electricity demand over the next decade.

As cheap wholesale power becomes available to electricity utilities, Integrated Resource Planning may become DSM's worst enemy. By requiring that utilities compare all options for providing end-uses to electricity consumers, and pick the "least cost" mix of supply-side and demand-side resources, the IRP approach may price DSM programs completely out of the market. Utilities providing electricity at high rates will often be able to reduce their costs more by purchasing wholesale power than by reducing their customers' demand. And to the extent that wholesale wheeling reduces rates, so will it reduce the cost-effectiveness of DSM programs, which rely on "avoided cost" measures of benefit.

**Where the Action Is**

Despite concerted opposition from utility and environmental forces, industrial power consumers (which pay up to a third of their operating costs in electricity bills) have persistently advocated deregulation of electricity generation. Their efforts have begun to pay off in recent months; in an attempt to retain investment in the state, California regulators have proposed a complete phase-out of the monopoly utility system from 1996 to 2002.[83]

In other states, entrepreneurs are advancing the cause of reform by appealing to the interests of smaller power consumers. Wheeled Electric Power, an electricity brokering company based in New York State, is petitioning state regulators to allow the citizens of Suffolk County to bypass the Long Island Lighting Company in favor of cheaper power.

Elsewhere, the process is moving more slowly, but the impetus for change is originating at the "grass roots" level, with small ratepaying citizens petitioning their government for access to the electricity superhighway. The outlook in New York state is particularly good; the state already allows some companies to "wheel" their power from power companies outside their service territories, and consumer support is very strong.

*DSM is largely opposed by commercial and industrial ratepayers, which seek to reduce its cross-subsidization effects and clear the way for competitive electricity markets.*

## CONCLUSION

Demand-Side Management is flawed both in theory and practice. Its theoretical foundation rests on the discredited theories of central economic planning, which presume that governmental and quasi-governmental institutions have the knowledge and incentives to economize on behalf of individuals.

Like all central economic planning schemes, DSM presumes that the preferences and detailed circumstances of individuals can be adequately known by others. As this paper has observed, such impossible requirements often compel DSM theorists to invent various proxies for subjective costs and benefits, including money prices and discounted profits. Unfortunately, all such schemes founder on misconceptions of the nature of such market phenomena. Prices are not costs, and market interest rates do not represent the "implicit" or subjective discount rates of individuals. In substituting money prices for costs, DSM employs the TRC and Societal tests of efficiency, which violate the Paretian efficiency test of the economist.

*Like all central economic planning schemes, DSM presumes that the preferences and detailed circumstances of individuals can be adequately known by others.*

In practice, DSM contains impossible Measurement and Evaluation (M&E) requirements, including the measurement of "free rider" effects, "strategic investors," and so on. This requires the DSM planner to engage in a guessing game about the efficacy of DSM programs, a game that is easily politicized and rendered a tool for boosting utility profits at the expense of ratepayers.

DSM's success can be effectively explained with a public choice model that understands it as a "racket," or a scheme to enable rent-seeking on the part of utilities, PUCs, environmentalists, some large industrial/commercial ratepayers, and utility planners and consultants.

DSM is largely opposed by commercial and industrial ratepayers, which seek to reduce its cross-subsidization effects and clear the way for competitive electricity markets. The outcome of that struggle will ultimately determine the fate of DSM, as well as the nature of the electricity industry in the United States.

## APPENDIX
## ENERGY EFFICIENCY VS. ECONOMIC EFFICIENCY

A proper economic analysis of DSM must rely on a clear distinction between energy efficiency and economic efficiency (also referred to as "cost-effectiveness"). The two phenomena are wholly separate, and accompany one another only incidentally.

Energy efficiency is a purely scientific concept, defined by Merriam-Webster as "the ratio of the useful energy delivered by a dynamic system to the energy supplied to it."[84] A simple example is that of electric lighting; if one light bulb produces the same quantity and quality of illumination as other bulbs, and uses less electricity, it is more energy efficient.

Economic efficiency, on the other hand, is a comparison of the benefits and cost of an activity[85] — if the benefits exceed the costs, the activity is said to be economically efficient. It is often supposed that economic "benefits" are properly equated with the dollar revenues generated by a productive activity, and "costs" with the concomitant dollar expenditures. But dollars are only a limited proxy for benefits and costs; in reality, a "benefit" or "cost" is subjectively experienced as such by the individual. Economic efficiency, therefore, is fundamentally a measure of human well being. When we are more efficient — that is, when the benefits we experience are greater than the costs — we are better off.

Relationships between energy efficiency and economic efficiency are purely incidental. No necessary connection exists between the two phenomena. In fact, they may be negatively related. An extreme example should illustrate the point. Assume that a new, energy efficient refrigerator is introduced into the market. The refrigerator uses one kilowatt less per year than other refrigerators, but costs $10,000 more. Clearly, one would be a fool to invest in such a refrigerator, even though it does improve one's energy efficiency.

It is equally naive to perceive energy efficiency investments as cost-effective because they will "pay for themselves" eventually. If, in our example we assume that one kilowatt costs one cent, then the refrigerator will "pay for itself" — in one million years. Such an investment is manifestly absurd, because the $10,000 could be committed to another investment, one that would "pay for itself" much more rapidly.

An imperfect way to judge the cost-effectiveness of energy efficiency investments is by comparing their rates of return to that of other investments. Economists normally compare investments by "discounting" the future energy savings of the investment. To discount future savings, one first determines the sort of investment with which to compare it — say, one with a 10 percent annual rate of return. Then, one calculates the "discounted" savings,[86] and compares them to the price of the investment. If the discounted savings are greater, then the energy efficiency investment is more cost-effective than investments with a 10 percent annual rate of return.

When individuals choose from among various investment opportunities, they normally don't use the discounting formulas of the economist as an explicit criterion. However, they do exhibit "implicit" discounting, by tending to purchase energy efficient technologies that pay for themselves more rapidly. Their judgements are based on a number of factors, including the quality of service provided by the energy efficient investment, how often they use the application, what they expect the future price of energy to be, how soon their existing application will need to be replaced, what other investment opportunities are available, and so on. Each individual examines energy efficiency investments from his own unique standpoint, one that is based on an intimate knowledge of his needs and preferences.

Utility DSM programs should always be judged according to their economic efficiency. The fact that they may improve the energy efficiency of utility customers is interesting, but not necessarily laudable. Contrary to the impassioned rhetoric of many DSM advocates, energy efficiency is not inherently beneficial or moral.

## ABOUT THE AUTHOR

Matthew C. Hoffman was a policy analyst at the Competitive Enterprise Institute, 1991 through 1994, specializing in energy regulation issues. His articles on electricity regulation have appeared in *Regulation*, *Consumer's Research*, *Reason*, and numerous other publications. He holds a degree in economics from George Mason University.

## ENDNOTES

[1] See Ronald Bailey, *Eco-Scam: The False Prophets of Ecological Apocalypse* (New York, St. Martin's Press, 1993), especially chapter four.

[2] Amory Lovins, "Energy Strategy: The Road Not Taken?" *Foreign Affairs*. (October 1976), pp. 65-96.

[3] Amory B. Lovins, "Long-term Constraints on Human Activity," *Environmental Conservation* (Spring 1976), pp. 3-4.

[4] Amory Lovins is now Director of Research at the Rocky Mountain Institute in Snowmass, Colorado.

[5] David Roe, *Dynamos and Virgins* (New York: Random House, 1984).

[6] Despite the popularity of this theory, it remains a minority viewpoint among climate experts. See Patrick J. Michaels, *Sound and Fury: The Science and Politics of Global Warming* (Washington, D.C.: Cato Institute, 1992), pp. 82-3.

[7] Clark W. Gellings and John H. Chamberlin, "Moving Towards Integrated Resource Planning: Understanding the Theory and Practice of Least-Cost Planning and Demand-Side Management," in *Least Cost Energy Planning in the Midwest: A Symposium,* EM-5846 (Electric Power Research Institute, June 1988) pp. 14-1 to 14-30.

[8] See James Buchanan, *Cost and Choice: An Inquiry Into Economic Theory* (Chicago: University of Chicago Press, 1969).

[9] The Union of Concerned Scientists, who promote a national DSM plan, as well as the California Energy Commission and the Northwest Power Planning Council, assess the benefit of an energy efficiency investment by comparing its rate of return to that of the long-term yield on U. S. treasury bonds, which is three percent!

[10] "Bright Ideas in Light Bulbs," *Consumer Reports*, October 1992, p. 664.

[11] Andrew Rudin, "The Compact Fluorescent Boondoggle," *Garbage* (Summer 1994), pp. 46-50.

[12] General Electric, Mazda Low Energy Lightbulb Box, *1993.*

[13] U. S. Department of Energy, *Insulation Fact Sheet,* DOE/CE-0180 (Washington, D.C.: 1988).

[14]Remarks by Len van Essen, Manager, Applied Research, Lennox Industries Inc. at the White House Conference on Global Climate Change, Washington D.C., June 10 and 11, 1993.

[15]Conversation with Eli Lieberman, Electrical Engineer, November 1993.

[16] Tyler Cowen, "Public Goods and Externalities: Old and New Perspectives," *The Theory of Market Failure* (Fairfax, VA: George Mason University Press, 1988), pp. 1-26.

[17]Or the one, in strict economic terms, that allocates resources such that the configuration results in a marginal rate of substitution for society that equals the slope of society's production possibilities frontier. See Francis M. Bator, "The Anatomy of Market Failure," *Quarterly Journal of Economics* (August 1958), pp. 351-79.

[18] Adam B. Jaffe and Robert N. Stavins, "The Energy Paradox and the Diffusion of Conservation Technology." Unpublished discussion paper, July 14, 1993, p. 10.

[19] Alliance to Save Energy, et al., *America's Energy Choices: Investing in a Strong Economy and a Clean Environment* (Washington, D.C.: Union of Concerned Scientists, 1991), p. 24.

[20] See, for example, Cowen, *The Theory of Market Failure.*

[21]For an excellent critique of such market failure theories, see Bernard S. Black and Richard J. Pierce, "The Choice Between Markets and Central Planning in Regulating the U.S. Electricity Industry," *Columbia Law Review*, Vol. 93, No. 6 (October 1993), pp. 1362-1370.

[22]Adam B. Jaffe and Robert N. Stavins, "The Energy Paradox and the Diffusion of Conservation Technology," unpublished discussion paper (Harvard University, July 14, 1993), p. 10.

[23]By assuming that all individuals live on the property lines of emission sources, and breathe the highest level of emissions from the sources for 70 years, 24 hours a day, the EPA estimates that between 1,700 and 2,700 of the almost one million new cancer cases each year are caused by toxic emissions. See Kent Jeffreys, "Rethinking the Clean Air Act Amendments," *Policy Backgrounder* No. 107, (Dallas: National Center for Policy Analysis, 1990), p. 6; and, Michael Gough, "How Much Cancer can EPA Regulate Away?" *Risk Analysis*, vol. 10 (1990).

[24]A 1992 Gallup poll of climate experts revealed that only 17 percent believe that warming over the last century was caused by man. A 1991 Greenpeace survey of members of the Intergovenmental Panel on Climate Change (IPCC) revealed that only 13 percent believed that continuing our current patterns of energy use would cause a runaway greenhouse effect, while 47 percent believed that this was "probably not" the case. See Patrick J. Michaels, *Sound and Fury: The Science and Politics of Global Warming*, (Washington, DC: CATO Institute, 1992), pp. 182-183.

[25] Albert Nicholes, "How Well do Market Failures Support the Need for Demand Side Management?" draft (National Research Associates, Inc. Draft, July 10, 1992), p. 23.

[26]Cost-effectiveness assumes a preexisting framework of constraints and trade-offs, but does not apply to a normative critique of that framework.

[27]Nicholes, p. 27.

[28] For a discussion of this issue, see Nicholes, pp. 19-23.

[29] F. A. Hayek, "The Pretence of Knowledge," Nobel Memorial Lecture, December 11, 1974.

[30] Roger F. Naill, "Developing a Least-Cost Strategy for Utilities," in *Least-Cost Energy Planning in the Midwest: A Symposium*, pp. 5-1 to 5-2.

[31] This is done by incorporating the cost in the "rate base" of the utility. For a fuller discussion of public utility regulation and the calculation of the rate base, see *Leonard Hyman, America's Electric Utilities: Past, Present, and Future*, 4th ed. (Arlington, VA: Public Utilities Reports, 1992), pp. 91-93.

[32] We assume for simplicity's sake that the utility sets its rate equal exactly to its long-run marginal cost (and earns no profit). In reality, utilities set their prices somewhat higher than their per-unit costs to earn a profit, and therefore lose profits from declining sales. This will be discussed in the next section on Electric Revenue Recovery Mechanisms, or ERAMs. Also, when energy use peaks at various times of the day, month, or year, costs can briefly exceed prices; this can also occur over the long run as demand for a utility's services gradually increases. In such cases, a Rate Impact Measure (RIM) test for efficiency can be applied that doesn't (in theory) allow ratepayers to cross-subsidize one another. This will also be addressed in a later section.

[33] For an in-depth explanation of the All Ratepayer test and other tests, see Clark W. Gellings and John H. Chamberlin, *Demand-Side Management: Concepts and Methods*, second ed. (Lilburn, GA: The Fairmont Press, 1992), pp. 267-326. Also see Eric C. Woychik, "Perspectives and Issues in Least-Cost Planning: Toward a Standard Practice Approach," in *Least-Cost Energy Planning in the Midwest: A Symposium*, pp. 2-1 to 2-28.

[34] The impact of hidden DSM taxes may be substantial. Some industrial utility customers in New York state are reporting net DSM surcharge costs of almost $700,000. See John P. Hughes and Barbara S. Brenner, "DSM: When Should Industrials Just Say No?" *Proceedings: 6th National Demand-Side Management Conference.* (Electric Power Research Institute, March 1993), pp. 227-231.

[35] Hughes and Brenner.

[36] Most notably, the Electricity Consumers Resource Council (ELCON). See, "Demand-Side Management (DSM)," *Profiles in Electricity Issues* No. 14. (Washington, DC: Electricity Consumers Resource Council, 1990), pp. 9-10.

[37] Ludwig von Mises, *Human Action*, (New Haven: Yale University Press, 1963), pp. 331-333.

[38] Ibid, 331.

[39] Larry Ruff, "Equity vs. Efficiency: Getting DSM Pricing Right," *The Electricity Journal* (November 1992), p. 29.

[40] Gellings, p. 306.

[41] Ibid.

[42]The economist Ludwig von Mises observes that prices are terms of exchange, and are therefore unintelligible without reference to a market: "Prices are a market phenomenon. They are generated by the market process and are the pith of the market economy. There is no such thing as prices outside the market. Prices cannot be constructed synthetically, as it were. They are the resultant of a certain constellation of market data, of actions and reactions of the members of a market society. It is vain to meditate what prices would have been if some of their determinants had been different. Such fantastic designs are no more sensible than whimsical speculations about what the course of history would have been if Napoleon had been killed in the battle of Arcole or if Lincoln had ordered Major Anderson to withdraw from Fort Sumter."

[43] See also Roy E. Cordato, "Energy Taxes, Externalities, and the Pretence of Efficiency," Institute for Research on the Economics of Taxation and Johns Hopkins University. Paper prepared for the Cato Institute conference, "National Energy Policy: Markets or Mandates" Washington, D.C., January 16, 1992.

[44] Ruff, p. 29.

[45] Paul Joskow, "Emerging Conflicts Between Competition, Conservation, and Environmental Policies in the Electric Power Industry," draft of keynote address for the Public Utilities Research Center's Conference on Competition in Regulated Industries, University of Florida, April 2-3, 1992, p. 18.

[46]Patricia Herman, "Workshop on The Use of Customer Value in the Evaluation of DSM." Prepared for California Energy Commission Staff, Barakat & Chamberlin, May 17, 1994.

[47]John H. Chamberlin, direct testimony, District of Columbia Public Service Commission, Rate Case 912, PEPCO (E), June 1993, p. 5.

[48]Larry Ruff, "Least-Cost Planning and Demand-Side Management: Six Common Fallacies and One Simple Truth," *Public Utilities Fortnightly* (April 28, 1988), p. 36.

[49]Ahmad Faruqui and John J. Chamberlin, "The Trade-Off Between All-Ratepayer Benefits and Rate Impacts: An Exploratory Study," *Proceedings: 6th National Demand-Side Management Conference* (Electric Power Research Institute, March 1993), p. 36.

[50] Cited in Albert J. Nicholes, *How Much Energy do DSM Programs Save: Engineering Estimates and Free Riders,* draft, (National Economic Research Associates, revised draft, July 24, 1992), p. 29.

[51]Ibid, 30-31.

[52]Stephen A. Johnston and Michael J. Kelleher, "Estimating Free Riders," *Proceedings: 6th National Demand-Side Management Conference*, p. 298.

[53] Albert J. Nicholes, *Estimating the Net Benefits of Demand-Side Management Programs Based on Limited Information*, revised draft (National Economic Research Associates, January 25, 1993), p. 36.

[54]DSM proponents actually admit their inability to measure these variables. See Gellings and Chamberlin, pp. 396-402. For more on the impossibility of measuring demand-side curves, see Mises, pp. 55-56 and pp. 351-354.

[55]This will occur whenever the ratepayer's elasticity of demand for the end-user in question is greater than one.

[56]Paul L. Joskow and Donald B. Marron, "What Does Utility-Subsidized Energy Efficiency Really Cost?" *Science*, Vol. 260 (April 16, 1993), p. 370.

[57]Ibid, p. 370.

[58]Steven M. Nadel and Kenneth M. Keating, "Engineering Estimates vs. Impact Evaluation Results: How do They Compare and Why?" in *Energy Program Evaluation: Uses, Methods, and Results* (1991), cited in Nicholes, *How Much Energy Do DSM Programs Save*, p. 8.

[59]Nadel and Keating attribute this effect to the "take back" effect, which is a function of demand elasticity.

[60]RCC/Hagler, Bailly, Inc. New Jersey Conservation Analysis Project: Final Contractor's Report to the NJCAT, prepared for the New Jersey Conservation Analysis Team, cited in Albert J. Nicholes, *How Much Energy Do DSM Programs Save*, p. 15.

[61]Massachusetts Electric, "1991 DSM Performance Measurement Report," submitted to Department of Public Utilities, Commonwealth of Massachusetts, cited in Nicholes, *How Much Energy Do DSM Programs Save*, p. 15.

[62] See Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions* Vol. 2 (Cambridge, MA: MIT Press, 1988), p. 49.

[63] Paula G. Rosput, "Least Cost Planning Under Uncertainty," *Least-Cost Energy Planning in the Midwest: A Symposium* (Electric Power Research Institute, June 1988) pp. 11-1 to 11-2. For a review of the uncertainties facing utility demand forecasters, see Duane T. Kexel, "The Ten Year Forecast — How Certain Are We?"

[64]Irwin M. Stelzer, "Demand-Side Management An Idea Whose Time Has Come and Gone?" Comments at the Aspen Institute1993 Policy Issue Forum: Energy, Environment, and Economy, Aspen, Colorado, July 10. 1993, p. 3.

[65]Public Choice economists refer to profit-seeking in the public sector as "rent-seeking" in order to distinguish it from the "ordinary" profit seeking behavior of firms and individuals in the private marketplace. "Rents" are profits gained by capturing control of the political process and extracting revenues and other benefits from those who are subject to them.

[66] Douglas A. Houston, *Demand-Side Management: Ratepayers Beware!* (Houston: Institute for Energy Research, November 1992), p. 26.

[67] Bernard S. Black and Richard J. Pierce, *The Choice Between Markets and Central Planning in Regulating the U.S. Electricity Industry* (unpublished manuscript, revised draft, August 1993).

[68]Houston, pp. 26-27.

[69] For more on the incentives for utilities to invest in DSM, see *Proceedings: Demand Side Management Incentive Regulation*, Electric Power Research Institute CU-6840, May 1990, pp. 21-28.

[70]Houston, pp. 29-30.

[71]Houston, pp. 26-27.

[72]James Clarkson and Allison Wade, Reply Brief of Southwire Company, presented to the State of Georgia Public Service Commission, December 11, 1992, p. 15.

[73]For a detailed discussion of the "retail wheeling" issue, see Matthew C. Hoffman, "The Future of Electricity Provision," *Regulation* (No. 3, 1994), pp. 55-62.

[74]The first such pool was the Pennsylvania-New Jersey Interchange, or PNJ, created in 1927. For a brief history, see Leonard S. Hyman, *America's Electric Utilities: Past, Present, and Future*, 4th ed. (Arlington, VA: Public Utilities Reports, 1992), pp. 91-93.

[75] Leonard S. Hyman, *America's Electric Utilities: Past, Present, and Future* (Arlington, VA: Public Utilities Reports, 1992), pp. 120-134

[76]Ibid., 143.

[77]PURPA's effects were delayed by an industry lawsuit that was finally resolved in favor of the government by the Supreme Court in 1982.

[78]Leonard S. Hyman. *America's Electric Utilities* pp. 326-334.

[79]Particularly the Electric Consumers Resource Council (ELCON).

[80]Paul Rogers, Michael Foley, and Ann Thompson, *Residential Electric Bills: Summer 1992* (Washington, D.C.: National Assoc. of Regulatory Utility Commissioners, 1993).

[81] Prudential Securities, *Electric Utilities: Competitive-Risk Study*, September 24, 1993.

[82] Ralph Cavanaugh, *The Great "Retail Wheeling" Illusion — and More Productive Energy Futures* (Natural Resources Defense Council, February 1994).

[83] Robert J. Michaels, *Restructuring California's Electric Industry: Lessons for the Other Forty-Nine States,* Institute for Energy Research, February 1995.

[84] Merriam-Webster Inc., *Webster's Ninth New Collegiate Dictionary* (Springfield, MA: Merriam-Webster Inc., 1988), p. 397.

[85]James D. Gwartney and Richard L. Stroup, *Economics: Private and Public Choice* (San Diego, CA: Harcourt Brace Jovanovich, 1987) p. 833.

[86]The discounted savings of an energy efficiency investment (or conversely, the discounted future income stream generated by a [illegible] bond) is actually the size of investment required to generate those savings given the rate of return [illegible]. If, for example, the discounted future savings of an energy efficient light bulb using a 10 percent annual [illegible] $20, then $20 is how much one would have commit to an investment earning a 10 percent rate of return [illegible] earnings.