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ACCELERATING THE ADOPTION OF CONSERVATION ENERGY

AVRAHAM SHAMA
KENNETH JACOBS

Solar Energy Research Institute
Golden, Colorado 80401

ABSTRACT

The absence of a marketing-oriented behavioral perspective from energy analysis presently dominated by an economic-engineering perspective is responsible for the low adoption rate of conservation energy. Unless these two perspectives are integrated, little can be expected in the way of speedy market penetration of conservation energy.

INTRODUCTION*

It is now well accepted that the U.S. buildings sector can "produce" 30 to 50 per cent of its energy needs by more efficient use of energy: i.e., by conservation. In fact, since the oil embargo of 1973, Americans have "produced" more new energy from conservation than from all other sources combined. Yet, the virtually infinite range of opportunities to improve energy efficiency in buildings has only begun to be tapped. The cost of such conservation energy is usually below that of imported oil or new electric generating capacity. But while the price is right, and the contribution to national security and environmental quality is enormous, the rate of adoption of conservation energy is surprisingly low.

This slow adoption of conservation energy constitutes "irrational" behavior on the part of consumers from the viewpoint of economic and engineering

*This paper highlights a more comprehensive work, *Energy Conservation in Buildings: A Behavioral Perspective,* (1980) by Kenneth Jacobs and Avraham Shama, Solar Energy Research Institute. For copies, contact the authors.

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analyses. From a behavioral perspective, however, such a slow rate of adoption may indeed be regarded as the outcome of perfectly "rational" consumer behavior. In our opinion, only a combined economic, engineering, and behavioral analysis can explain consumer adoption of conservation energy and help accelerate its market penetration.

ECONOMIC-ENGINEERING PERSPECTIVE

Economic-engineering analysis identifies abundant opportunities to save energy and money, without affecting comfort and convenience. This is established by comparing the cost of a given conservation measure to the cost of energy it saves. Such an analysis has been performed on many buildings and their energy-using appliances, and simulated many times to convince even the doubtful researches that investments in energy conservation are quite profitable. Accordingly, conservation energy investments which often pay for themselves in less than three years include:

- caulking, weatherstripping, and other "leak-plugging;"
- regular maintenance of appliances, such as changing furnace filters;
- wrapping insulation blankets around hot water heaters; and
- using spark ignition rather than pilot lights in new gas appliances.

Other conservation energy investments may take longer to pay for themselves, and yet—paradoxically—are being widely adopted. These include:

- insulating ceilings, walls, floors, and ducts; and
- storm windows and doors.

Finally, depending on conservation energy investments already in place, other innovative conservation technologies may take different times to pay for themselves. Examples are:

- passive solar designs which normally combine proper building and window orientation, extensive insulation, and other features;
- heat pumps—a more efficient use of electricity for space heating than conventional electric resistive space heating.

Though each of the above measures conserves energy, the combined impact or "interrelatedness" of various conservation measures is not additive. Engineering-economic analysis has only begun to address this phenomenon.

BEHAVIORAL PERSPECTIVE

The behavioral perspective of conservation energy includes two concepts. The first is that some changes in consumer behavior are, in themselves, important sources of conservation energy. The second is that conservation energy is an innovation whose use is determined by behavioral factors.

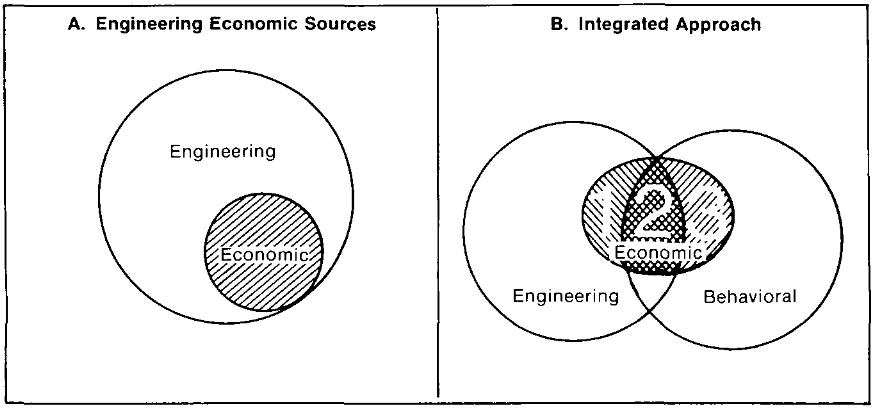


Figure 1. Conservation Energy Sources.

Figure 1A represents conservation energy sources from an economic-engineering standpoint. The shaded area represents cost-effective engineering measures. The integrated approach combines a behavioral perspective with that of economic-engineering. As a result, three types of sources are now available: engineering measures (1), behavioral measures (3), and measures which combine engineering and behavioral changes (2). An example of the latter is a thermostat setback device which facilitates turning down the temperature. Each of these types of measures must result in an increase in perceived welfare in order to be "economic."

Figure 1 depicts the significance of the first concept; that is incorporating consumer behavior changes paves the way to exploit more sources of conservation energy than are available by engineering improvements alone. Such additional opportunities (area 3 in the figure) include thermostat setbacks; lower water heater temperature; opening and closing curtains and windows to ventilate, insulate, and heat a building as desired; and turning off lights in unoccupied rooms. The economic advantage of these opportunities is obvious.

U.S. energy policy makers have generally been reluctant to acknowledge these behavior-related opportunities for fear of being accused of advocating drastic changes in lifestyles. Yet, as the above examples illustrate, such opportunities require little that one could characterize as "drastic." Further, a growing number of Americans have adopted energy-efficient lifestyles. These people are mining a source of conservation energy which can benefit society at large.

Engineering-economic analysis which excludes behavioral sources of conservation energy may result in erroneous consumer and societal decision-making. In fact, the use of behavioral sources may help explain the relatively low rate of adoption of some engineering sources of conservation energy. For example, an engineering assessment of the conservation potential in a house may result in misleading recommendations regarding insulation if it assumes that a

70-degree temperature is maintained while in fact the occupants have already changed their behavior and now produce conservation energy by keeping a much cooler house.

This behavioral concept may also help explain the difficulty of achieving optimal energy saving in rented or leased residential and commercial buildings. If engineering innovations could bring about optimal conservation, then making landlords responsible for all utility bills would be appropriate. If energy consumption were only a function of behavior, then renters should pay utility bills. However, as both engineering and behavioral innovations can decrease energy consumption, it is extremely difficult to induce maximum conservation in rented buildings via the price mechanism.

The second behavioral concept, that of diffusion of innovations, helps explain the low adoption rate of conservation energy, which often puzzles economists and engineers. Once engineering analysis shows conservation energy to be cost-effective, maximum and immediate market penetration is normally assumed. For this to take place, conservation energy must be instantaneously:

1. adopted by over 75 million U.S. households and millions of businesses, composed of over 250 million people.
2. used in amounts and mixes (with fossil fuels) as required by engineering and economic analysis;
3. affordable by all U.S. households;
4. physically available to all consumers; and
5. perceived as having little or no economic, social, and psychological risks.

It takes little expertise, however, to conclude that these conditions cannot be easily and quickly met.

We offer the diffusion of innovation framework as a suitable framework to discuss conservation energy, as well as offer some suggestions as to how to compress the adoption process of conservation energy innovations.

DIFFUSING CONSERVATION ENERGY

Conservation energy is an energy innovation represented by many combinations of measures. Though, as mentioned earlier, individual conservation measures have already been adopted by many consumers, we discuss conservation energy as a "package" or a "system" designed to achieve an optimal level of energy conservation. One such package might include reduced infiltration, furnace modifications, and thermostat set-back, while another might include reduced infiltration and insulation.

Innovations do not get adopted overnight. Rather, the adoption process is composed of several psychological stages (awareness, interest, evaluation, trial, and adoption) that the consumer goes through before final adoption. In each of these stages, the consumer may decide that, all in all, his/her present way of buying and using energy services is preferable over getting such services from conservation sources. Depending on consumer motivation and background, and his/her perception of the innovation's attributes as compared with the attributes of other energy services, different consumers go through the adoption process at different times and rates. Those who are first to introduce the innovation are the innovators, followed by early adopters, early majority, late majority, and laggards (and some never adopt an innovation). These groups have been profiled in many studies to suggest their applicability to conservation energy innovations [1]:

Innovators (2½% of the market)	These are young, of high social and economic status, risk takers, cosmopolitan, and prefer impersonal communication sources.
Early adopters (13½% of the market)	These too are young and of high social and economic status, seek respect, and are extremely capable opinion leaders. Once they adopt an innovation, others are sure to follow.
Early majority (34% of the market)	These are of average social and economic status, love to show or tell their peers of products they purchase, and are followed by the late majority.
Late majority (34% of the market)	As these are of below average social and economic status, they are skeptical about adopting new products. Adoption occurs when the price is low enough and the pressures to adopt are strong.
Laggards (16% of the market)	Last to adopt, these consumers have low social status and income, their values are very traditional, and they are reluctant to purchase and use new products and services.

Equally important is the way consumers perceive the attributes of an innovation. Such perceived attributes may accelerate or hamper the adoption process. Again, diffusion research has identified several factors affecting the rate of adoption. Applied to conservation, these factors are:

Relative Advantage	that is, the degree to which conservation energy innovations appear superior to other energy services in such terms as lower price, ease of use, reliability, and social desirability. The greater the perceived relative advantage, the faster the rate of adoption.
Compatibility	that is, the degree to which the use of conservation energy is consistent with the values of potential adopters, and their experience with products that

the innovation may replace. Compatibility and fast adoption rate are positively related. Thus marketers and policy makers should emphasize that the services provided by conservation energy are very similar to those provided by conventional energy sources.

Complexity — or the difficulty of understanding what conservation energy is all about, how to use it and the ease with which different conservation measures may be used. Complexity hampers adoption.

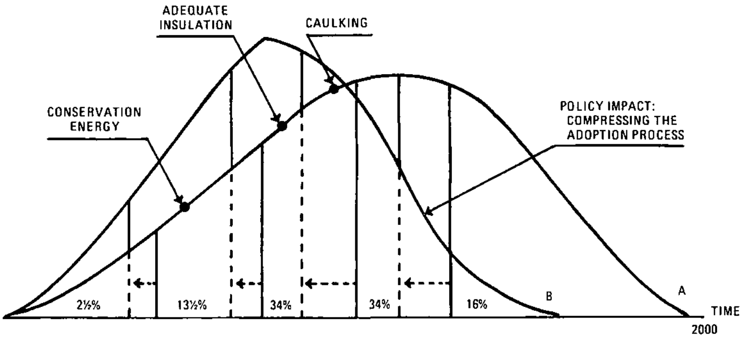
Divisibility — that is, the degree to which the innovation can be adopted on a limited basis. Today, the high divisibility of conservation energy hampers the adoption of systematic conservation packages. Yet this high divisibility can be used advantageously to design different packages of conservation measures to fit the needs of various market segments.

Communicability — that is, the ease with which the results of using conservation energy may be observed and communicated. As conservation measures are used to "produce" energy services, one way to communicate the relative advantage of conservation is by comparing energy bills before and after the adoption of conservation.

Both the diffusion process and its mirror image—the adoption process—have significant implications for policies aimed at accelerating the adoption rate. Knowledge of relevant marketing principles may also be applied to accelerate the adoption rate of conservation energy innovations.

Figure 2 presents the adoption of conservation energy over time, adopter category, policy measures, and marketing variables of product, price, promotion, and distribution. Two diffusion curves, A and B are depicted. Curve B compresses the process depicted in Curve A. In our opinion, *that is the best that conservation energy policy can do: to compress the process of adoption into a shorter time.* Even then, carefully and flexibly formulated policies capable of adapting to different markets and consumer needs at the different stages of the adoption are required.

Business and policy measures which consider innovation attributes and consumer characteristics can affect the adoption of conservation energy by fine-tuning product, pricing, promotion, and distribution decisions.



MARKETING FACTORS	INNOVATORS	1980 EARLY ADOPTERS	EARLY MAJORITY	LATE MAJORITY	LAGGARDS	
PRODUCT:						
INNOVATION ATTRIBUTE	INNOVATIVENESS	INNOVATIVENESS, RELATIVE ADVANTAGE → LOW RISK →	COMPATIBILITY → WARRANTY → SERVICING →			
PRODUCT CONCEPT		LESS COMPLEX PRODUCT FUNCTIONS →				
PRODUCT DIFFEREN-TIATION			IMPORTANCE OF PRODUCT DIFFERENTIATION →			
PRODUCT LINE	LIMITED	LIMITED-EXTENSIVE	(SEGMENTATION) →			
POLICY MEASURE	R&D	DEMONSTRATION → CONSUMER PROTECTION → STANDARDS AND LABELS →	TRIAL →			
PRICE:	SKIMMING (HIGH) OR PENETRATION (LOW PRICE)	SKIMMING OR PENETRATION	PENETRATION → PROMOTIONAL PRICING (E.G., QUANT. DISCOUNT) →			
POLICY MEASURE		PRICE REDUCTION FOR TRIAL → TAX CREDITS AND REBATES → FINANCIAL SERVICES (e.g., CONSERVATION BANK) →				
PROMOTION:						
MESSAGE		INFORM	PERSUADE	PERSUADE AND REMIND →		
MEDIA	SPECIALIZED MEDIA	SPECIALIZED MEDIA	MASS MEDIA →			
PERSONAL SELLING	LIGHT	LIGHT	HEAVY	HEAVY →		
PUBLICITY		HEAVY	HEAVY	LIGHT →		
POLICY MEASURE		DEMONSTRATION →				
DISTRIBUTION:		SELECTIVE	MASS (MARKET SATURATION) →			
POLICY MEASURE		SUPPORT WIDE DISTRIBUTION →				

Figure 2. Adoption Curve and Marketing Strategy: Applications to Conservation Energy

Product

Product innovations exhibiting relative advantage and having value to the consumers get adopted quickly. In the case of energy conservation, the measures of weather stripping, storm windows, and thermostat set-backs are well along the adoption curves as separate measures. However, taken in combination as a conservation energy innovation, it is in the early stages of the diffusion process. Unfortunately, we still lack a clear understanding of the combined impact of any given package of conservation energy measures. Yet Carhart et al. report that 6 per cent of single-family homes have adopted near optimal levels of conservation energy [2]. Thus, it appears that the innovation stage is past and that conservation energy is now in the early adopter stage.

To facilitate faster adoption, one must establish better, more reliable consumer information as to what the innovation of conservation energy is all about, where to obtain it, how to use its various components in combination, how it fits present energy practices, and its relative advantages.

Thus, policies aimed at accelerating the rate of adoption may sponsor projects designed to transform discrete conservation products into conservation energy systems.

Such opportunities exist for both the private and public sectors. Conservation energy stores and businesses can help consumers understand the "interrelatedness" of the products they sell. Energy audits to be offered by utilities under the Residential Conservation Service (RCS) program will offer participants an evaluation of different conservation and solar measures tailored to their homes, and estimate their separate cost and payback period. However, they will *not* be advised as to the combined effectiveness and payback of any *combination* of such measures, nor otherwise be aided in choosing such conservation energy packages.

Pricing

While in the early innovation stage setting a high price to skim the market may be practiced, any meaningful and fast penetration would not be achieved without price reduction. This is particularly true when the innovation is comprised of simple products produced and sold competitively. As it was shown, the price of conservation energy is often lower than its energy alternatives. The availability of 15 per cent (up to $300) tax credit (delayed until the following season) makes conservation energy even cheaper. Thus, price per se does not seem to deter adoption. However, as the total cost of retrofitting a home may be as much as $2,000 to $3,000, the absence of financial services may reduce the rate of adoption and the degree of use of conservation energy. To deal with this high first-cost problem, policies which facilitate financial services for energy conservation may accelerate its rate of adoption. The Tennessee Valley Authority (TVA) has recently made conservation loans available to its customers. The demand for such loans was so strong that TVA had to de-market its program temporarily in order to ease demand pressures. Similarly, as the Conservation Bank begins to grant loan principal and interest subsidies to qualifying lower income applicants through local financial institutions, it may accelerate the rate of conservation energy adoption.

Promotion

As can be seen in Figure 2, at the early stages of adoption promotion is used to inform the consumer of the innovation, its function and use, and later it is used to persuade and to remind the consumer to continue using the innovation. In addition, while in the early stages selective promotion is advantageous, mass communication and personal selling may produce better results later on.

Conservation energy policy may use informational or educational materials to inform the consumer of the innovation, and/or present conservation energy as a profitable business opportunity to the business sector. Later, more persuasive messages may be more effective, In our opinion, now is the time for this more persuasive stage.

Several energy conservation programs aim to establish the relative advantage of conservation energy over traditional energy sources, and communicate its relative advantage to the large adopter groups of the early and late majority. Thus, RCS will require major utilities to offer conservation energy tips and individual home energy audits to most households and small businesses over the coming five years (it is estimated that 35 per cent of all households will in fact be audited); the Schools and Hospitals Program authorizes $900 million in matching grants to retrofit these institutions; the Federal Energy Management Program aims at increasing the use of conservation energy in federal buildings; and the experimental Residential Energy Efficiency Program will seek to induce extensive use of conservation energy in select areas of the U.S. and examine the cost-effectiveness of such energy from the point of view of utilities.

As promotion is aimed at changing behavior, mandating energy-efficient practices may be regarded as a form of promotion. Mandates may be mild (e.g., requiring energy efficiency information regarding appliances and buildings), or strict (e.g., requiring strict and immediate practices such as thermostat set-backs or attic insulation). Performance-based mandates–such as Buildings Energy Performance Standards (BEPS), now being developed–fall within this range. Mandates can at best shorten the diffusion process. Thus requiring information disclosure or performance standards may be more flexibly applied, presuming neither instant nor universal adoption.

Distribution

While the delivery system may be selective or intermittent in the innovation stage, it must become efficient, easy to identify by the consumer, and quickly accessible to him/her as the early adopters and early majority enter the market. Presently, the scant and selective distribution structure hampers the rate of adoption of conservation energy. Conservation energy information, loans, products, and services must be available through reliable, accessible local sources. Current conservation programs are to be delivered through utilities (e.g., RCS), local financial institutions (e.g., Conservation Bank), and home improvement contractors (e.g., RCS). It is unclear whether all market segments, particularly the poor, regard utilities and local financial institutions as reliable and accessible. Home improvement contractors also may not be regarded as unbiased sources of conservation energy information.

CONCLUSIONS AND RECOMMENDATIONS

The absence of a marketing-oriented behavioral perspective from business and public policies dominated by economic-engineering analysis is a major reason for the disappointingly low penetration rate of conservation energy. Unless the behavioral and economic-engineering perspectives are integrated, little can be expected in the way of speedy penetration of conservation energy.

It should be emphasized here that a behavioral perspective includes two elements. First, changes in consumer behavior (i.e., turning down the thermostat) can continue to be important sources of conservation energy. Second, the diffusion of innovation framework can be used to make public and business policies aimed at acceleration of consumer adoption of conservation energy. Specifically, using the diffusion of innovation framework, we make the following recommendations.

Develop Conservation Energy Systems

Business, with government support as necessary, should develop conservation energy systems capable of "producing" energy services at less cost and with higher reliability than energy services provided from new or imported sources of energy supply. Though familiar measures such as caulking and thermostat set-back do "supply" some conservation energy, the potential of conservation energy cannot be realized without a complete line of conservation energy systems or packages which must be known, available, and needed by the consumer. However, the combined impact of individual engineering and behavioral ingredients of such systems is not simple additive. Engineers, home energy auditors, and energy economists must more accurately evaluate these combined impacts.

Target Conservation Energy Systems

Presenting different product concepts, attributes, and lines to different adopter categories is essential to speedy market penetration. For example, these systems can emphasize either engineering or behavioral measures, or a combined response. Private sector marketers will generally have an incentive to emphasize engineering-oriented options. Thus the public sector must see that behavioral options are also presented (i.e., there is little profit motive in urging people to turn down the thermostat).

Inform And Motivate The Consumer

Information about conservation energy is essential to the consumer decision-making process. One cannot assume that because consumers know about some of its ingredients, they also know about the innovation. Different information mix may be needed at the different stages of the consumer adoption process. Factual product information designed to create consumer awareness of conservation energy systems should be used in the early stages of the adoption process; later, product information must convince the consumer that such systems can meet the specific needs of his/her household, and thus create purchase motivation. Similarly, different communication channels should be used at the different stages of the adoption process. While mass media such as television are effective in creating awareness, specialized media such as do-it-yourself magazines and personalized information from energy auditors are more effective in convincing potential adopters. In all cases, source credibility is of decisive importance.

Consider Marginal Social Cost Pricing

As long as the price of conventional sources does not fully reflect their marginal social cost, potential adopters of conservation energy will continue to impose a cost on society. Yet a great deal of conservation energy is now cost-effective, even without marginal pricing. Nevertheless, marginal pricing can speed the diffusion process. Other policy measures, such as loans and information programs, may be employed to complement marginal social pricing and ease the burden it creates.

Offer Financial Services

Because full adoption of conservation energy may require the consumer to invest as much as $2000 to $3000, the availability of financial services is essential to speedy market penetration. The Conservation Bank is a step in the right direction, whose practical value should be determined by its implementation.

Ensure Appropriate Distribution

Distribution channels must be in place before conservation energy can penetrate the market. Presently, the absence of credible mass distribution channels slows the diffusion of conservation energy. Business and government policies should encourage a wide distribution of conservation energy systems.

Discourage Energy-Inefficient Practices

In addition to positively reinforcing energy-efficient practices, energy-inefficient practices should be discouraged. For example, differential pricing such as increasing-block utility rates or demand billing may produce energy-efficient practices.

Use Flexible Mandates

Mandates to induce the adoption of conservation energy must be regarded as an available policy tool. Information and performance-based mandates can be both flexible and effective in speeding the adoption of conservation energy systems.

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Direct reprint requests to:

Kenneth Jacobs
Solar Energy Research Institute
1536 Cole Blvd.
Golden, CO 80401