

Two Pathways To Energy Efficiency: An Energy Star Case Study

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Abstract

While many voluntary environmental initiatives have focused on interactions between firms and regulators, voluntary product-labeling programs are designed to alter the relationship between firms and their customers. By providing information that prices alone cannot, product labeling has the potential to enable customers to respond to the “green” attributes of a product, allowing the preferences of customers and other stakeholders to influence company decisions concerning energy efficiency or other environmentally desirable objectives.

Despite the potential for both producers and consumers to gain from better information, voluntary product labeling schemes addressing energy efficiency have not emerged in the absence of government intervention. Voluntary public policies to label products have shown significant potential to influence producer and consumer decisions. However, the mechanics of these programs and the industry dynamics they produce remain largely unexplored.

This paper describes two voluntary labeling programs in order to illustrate two different mechanisms that have become common archetypes in voluntary initiatives. Converging mechanisms lead all targeted firms to adopt a similar, desired behavior. Separating mechanisms drive firms to segregate into different types based on their environmental performance, allowing external audiences to reward each type differently. The government sponsors of programs choose policy instruments such as product labels, government procurement preferences, and in some instances negotiations to help determine which type of mechanism will develop.

The paper illustrates the differences between these two archetypes by describing the Energy STAR programs for office products and washing machines, and suggests circumstances in which each type of mechanism may be more feasible and more desirable to create.

Introduction

While many voluntary environmental initiatives have focused on interactions between firms and regulators, voluntary product-labeling programs are designed to alter the relationship between firms and their customers. By providing information that prices alone cannot, product labeling has the potential to enable customers to respond to the “green” attributes of a product, allowing the preferences of customers and other stakeholders to influence company decisions concerning energy efficiency or other environmentally desirable objectives.

Despite the potential for both producers and consumers to gain from better information, voluntary product labeling schemes addressing energy efficiency have not emerged in the absence of government intervention. Voluntary public policies to label products have shown significant potential to influence producer and consumer decisions. However, the mechanics of these programs and the industry dynamics they produce remain largely unexplored.

For the past few decades, the vast majority of public policies to address energy and environmental issues have relied on regulations or taxes to affect producer behavior. Product labeling programs attempt to influence producers’ behavior more indirectly, by influencing or threatening to influence consumer preferences. The Energy Star programs administered by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) have been very successful examples of this type of initiative. Such programs have powerful potential, providing opportunities for corporations to advertise and profit from their superior environmental performance.

This paper illustrates two different mechanisms that have become common archetypes in voluntary initiatives. *Converging* mechanisms lead all targeted firms to adopt a similar, desired behavior. *Separating* mechanisms drive firms to seg-

regate into different types based on their environmental performance, allowing external audiences to reward each type differently. The government sponsors of programs choose policy instruments such as product labels, government procurement preferences, and in some instances negotiations to help determine which type of mechanism will develop.

The paper illustrates the differences between these two archetypes by contrasting two government-sponsored voluntary product labeling programs. This paper contrasts two specific efforts — the Energy Star Office Products program administered by EPA and the Energy Star Clothes Washer program administered by DOE — which have succeeded by following distinctly different pathways. The Clothes Washer program illustrates the dynamics of a separating mechanism — in which a voluntary program heightens competition among manufacturers. The Office Products program illustrates the dynamics of a converging mechanism — in which a voluntary program provokes a common response among virtually all manufacturers in an industry. Both programs have created mechanisms that have begun to fundamentally transform the markets for these two product categories.² However, they have driven change in very different ways.

This analysis is based on industry and government publications, interviews with government program officers and contractors, and telephone interviews with company managers. The industry interviews³ covered firms representing more than 99% of the U.S. clothes washer industry (six interviews), and more than 55% of the U.S. desktop computer industry (five interviews and one written response to questions).

The paper begins by exploring the logic of voluntary product-labeling programs and introducing the separating and converging mechanisms. Next, it introduces the Energy Star program and contrasts the two initiatives. The following two sections describe each effort in greater depth. The analysis then focuses on how the separating and converging mechanisms work. The final section summarizes the insights gained through comparing the two programs.

The Logic of Voluntary Product-Labeling Programs

In many instances firms could improve the energy efficiency of their products voluntarily instead of waiting for mandatory performance standards. However, market responses to the presence of “hidden information,” knowledge available to one party to a transaction but not to another, may prevent voluntary action (See Macho-Stadler and Perez-Castrillo 1997) and thus lead to “adverse selection.”

Adverse selection occurs when uncertainty about product characteristics reduces the number of transactions, modi-

fies the terms of transactions, or eliminates them altogether. The archetypal example is the “market for lemons” problem, described by Akerlof (1970), in which used car sellers have private information about the quality of their vehicles, but potential buyers must assess their value using only publicly available information. The possibility that any given car offered for sale could be a “lemon” reduces the potential value of all cars and discourages the owners of better cars from offering them for sale. In extreme cases, adverse selection can prevent any products from being sold.

Adverse selection has greatly limited the development of energy efficient products. Howarth and Andersson (1993) observe that growth in the market for energy efficient products has been inhibited by inefficient transfer of information between producers and consumers. They point out that consumers:

rely heavily on manufacturer reputation and previous experience in owning and operating equipment — factors which reflect past rather than present equipment performance

(Howarth and Andersson 1993, 268).

Reliance on old information may perpetuate the use of outdated technologies, even though the net effect is economically inefficient. Howarth and Andersson’s model indicates that public policies can offset this informational asymmetry.

Studies on “voluntary overcompliance” have examined how voluntary initiatives might encourage firms to improve the energy efficiency of their products. Arora and Gangopadhyay (1995) demonstrate that under complete information some firms will modify their manufacturing processes or product mix if customers will pay more for greener products. In this situation, less-environmentally-conscious firms will meet legal requirements, while more-environmentally-conscious firms will voluntarily overcomply.

Kirchoff (1999) demonstrates how firms might benefit from an institution that encourages them to “overcomply.” Firms can inform customers about an environmentally superior offering by publishing claims about their own product or adding a label indicating participation in an externally validated program recognizing greener products. Under asymmetric information, consumers are uncertain about the validity of firms’ product claims and are therefore less willing to pay a premium. A third-party labeling system can certify producers’ claims and deter false claims. Such a mechanism enhances social welfare and economic efficiency by increasing the supply of the green products that customers prefer at higher profit levels, benefiting firms.

The economic literature on signaling describes mechanisms that can deter producers from making invalid claims and allow consumers to make effective choices under asym-

metric information (Spence 1974; Stiglitz 1975). Under carefully specified conditions, signaling models lead informed parties to provide signals that allow the uninformed parties to make decisions as if they had detailed knowledge of the informed party's private information.

To use a signaling mechanism, producers invest in communicating the important attributes of their products or services (Spence 1974). In a favorable response, customers will pay more for these products. Stiglitz (1975) introduced the related concept of screening, a model in which buyers create market opportunities that lead producers to tout the desirable characteristics of their products. Voluntary initiatives include a third alternative, closely resembling the screening model, in which a third party, e.g. a government agency or a non-government organization (NGO), encourages producers to signal the superiority of their products to potential customers.

Rothschild and Stiglitz (1976) introduced the concepts of "pooling" and "separating" to address the effectiveness of a screening mechanism. A separating mechanism enables companies to reveal the information that their products are superior. A pooling mechanism fails to change producers' behavior because it does not effectively differentiate superior products (in this case in terms of energy efficiency) from others. In this case, customers will behave as if all the products are equally desirable, and producers will not change the mix of products they offer.

This study introduces the concept of a "converging" mechanism⁴, to supplement the "pooling" and "separating" mechanisms identified by Rothschild and Stiglitz. A converging mechanism has the effect of changing all products, and signaling to the buying public that the industry has adopted the desired behavior.⁵

Virtually all successful voluntary initiatives to date have succeeded by creating either a converging or separating model. Converging models have been prevalent in Europe in industry wide negotiated agreements (OECD 1999). North American voluntary initiatives have employed a mix of separating and converging mechanisms.

The Energy Star Office Products and Clothes Washer programs illustrate the basic differences between separating

and converging mechanisms common in voluntary environmental initiatives. Table 1 summarizes the key attributes of these mechanisms. Each approach can reward firms for improving their environmental performance and discourage firms from providing misleading information. Although converging and separating mechanisms work in very different ways, both can lead to substantial market transformations.

The Energy Star Program

The Energy Star initiative is a family of voluntary programs designed to increase energy efficiency and reduce carbon emissions. EPA introduced Energy Star in 1993 as a voluntary labeling program to identify and promote energy-efficient products. EPA subsequently partnered with DOE in 1996 to promote the Energy Star label and broaden the range of activities it covered. Over the past few years, Energy Star has expanded to cover 31 product categories, including residential and commercial buildings, residential heating and cooling equipment, major appliances, lighting, and consumer electronics. Cumulatively, by 2000 the Energy Star program had saved an estimated 1,130 petajoules (10^{15} joules) of primary energy and avoided the emission of an estimated 20.7 MtC of carbon (Webber et al. 2000).

The mission of the Energy Star program is to "realize significant reductions in emissions and energy consumption by permanently transforming markets for energy-consuming products" (Brown et al. 2000). Energy Star initiatives pursue several interrelated strategies including setting standards for the label; labeling energy efficient products; providing objective information to consumers; working with national, regional, and local groups to promote energy efficiency; and lowering the costs of owning energy efficient equipment and products through alternative financing (EPA 1998a).

The program has achieved considerable success, both in terms of the percentage of each target industry participating and the reductions achieved in energy consumption, carbon emissions, and expenditures. In 1999, Americans purchased more than 100 million Energy Star-compliant products, representing approximately a 20% market share for the product categories addressed by the program (Brown et al. 2000). In addition, the Energy Star label and standards have become a de facto international standard. It has been adopted by Japan, New Zealand, Australia, and recently, the European Union.

The Energy Star Clothes Washer program and the Energy Star Office Products programs have been successful in two industries with striking differences. The washing machine industry is relatively mature, with very modest growth while the personal computer industry grew by more than 500% from 1990 to 2000. Figure 1 shows unit shipments for these two industries. The two industries also differ in their degrees

Table 1. Mechanism types.

Type	Key features	Example
Separating	Firms choose whether or not to participate, or choose a level of participation. As a result, firms separate into a small number of types.	Energy STAR Clothes Washer program.
Converging	Firms in a targeted group all choose to make a desired level of improvement in performance.	Energy Star Office Products program.

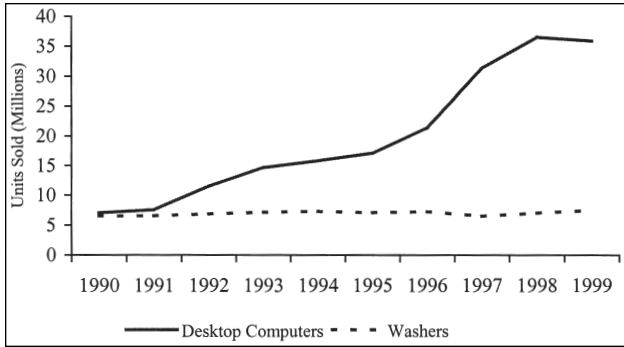


Figure 1. Unit shipments of clothes washers and desktop computers, 1990-99.

of market concentration, pace of innovation, and intensity of price competition. Table 2 highlights several significant differences between the industries.

The U.S. clothes washer industry has traditionally been quite stable. It is highly concentrated, with the top three companies (Whirlpool, Maytag, and G. E.) accounting for 89% of the U.S. market, and the top five companies accounting for more than 99%. Whirlpool has been the market leader for more than 40 years, with a 53% share of U.S. sales in 1999 (Appliance 2000).

The Energy Star Clothes Washer program has achieved moderate success to date. The majority of washers sold are still not Energy Star models and industry participants believe that Energy Star-compliant clothes washers constitute a small percentage of the existing stock. However, as described below, the entire industry has recently committed to mandatory energy efficiency standards for all clothes washers that exceed the current Energy Star voluntary standards.

Cumulatively, the Energy Star clothes washers saved an estimated 31 petajoules of primary energy from 1996 to 2000, and prevented emissions of an estimated 0.0076 MtC of carbon. The program is expected to save 340 petajoules of primary energy from 2001 to 2010, and prevent emissions of an estimated 18 MtC of carbon. These savings have reduced energy expenditures by \$220 million from 1996 to 2000, and are expected to reduce energy bills by \$16 billion from 2001 to 2010 (Webber et al. 2000).

The U.S. office products industry includes manufacturers of personal computers, monitors, printers, multifunction devices, and copiers. This study focuses on the desktop computer segment of that industry. This industry is intensely competitive, with more than 50 manufacturers vying for market share. Market leadership is fragmented and the leading firm has changed several times over the last decade. Competition is characterized by rapid turnover of product models and constant pressures to reduce prices and increase performance. Although branded products command more than 50% of the market, a sizeable portion of the market is addressed through “white box” products sold under the names of retail establishments.

The Energy Star Office Products program achieved an estimated 80% market share for computers, 95% for monitors, and 99% for printers by 2000 (Brown et al. 2000). Cumulatively, the program saved an estimated 360 petajoules of primary energy from 1993 to 2000, and prevented emissions of an estimated 2.8 MtC of carbon. The program is expected to save 2,200 petajoules of primary energy from 2001 to 2010, and prevent emissions of an estimated 33 MtC of carbon. These savings reduced energy expenditures by \$2.5 million from 1996 to 2000, and are expected to reduce energy bills by \$14 billion from 2001 to 2010 (Webber et al. 2000).

Table 2. Characteristics of two Energy Star programs.

Characteristics	Clothes Washers	Office Products
Industry organization	Highly concentrated. Top 5 firms command 99% + of U.S. market share.	Moderately concentrated. Top five firms command 57% of the U.S. market.
Basis of competition	Products differentiated on features, quality and price.	Leading products very similar in price and features.
Price trends	Prices relatively stable.	Price/performance ratio continually moving downward. Price a dominant factor in customer choice.
Brand	Products sold under national brand names.	More than 50% of products sold under brand names. Many products sold under retailer’s private label.
Innovation	Moderate innovation. Innovations enabled by key suppliers. Fundamental innovations relatively infrequent.	Constant rapid innovation driven in part by chip manufacturers and software firms. Turnover of basic technology every 1-2 years.
Regulatory threat	Energy efficiency standards in place before program began. Legislative mandate to review standards every 4 years.	No legislative mandate for energy efficiency standards.
Program administration	U.S. Department of Energy	U.S. Environmental Protection Agency
Retailer involvement in program	High	Low

These two industries provide striking contrasts in terms of the competitive environment, the pace of technological innovation, and many other variables. The Energy Star programs that address these two industries also differ in very striking ways. The next two sections describe the Energy Star Clothes Washers and Office Products programs in greater depth.

The Energy Star Clothes Washers Program

The Energy Star Clothes Washers program, administered by DOE, illustrates the dynamics that can occur when a voluntary program encourages firms to differentiate their products on a desired dimension. It allows manufacturers to use the Energy Star label on any washers that meet a level of energy efficiency significantly exceeding that required by current regulations. The Energy Star program contributed to a technology race among clothes washer manufacturers, leading to product innovations affecting energy efficiency as well as several other elements of product design. In response to the Energy Star program, several manufacturers adopted a horizontal axis design widely used in Europe, while others developed new designs for vertical axis machines that substantially reduced water and energy consumption.

Interviews with six industry participants (representing more than 99% of the U.S. market) revealed sharply different reactions to the program in terms of customer demand for energy efficient products and the nature of the opportunity the program presented. Some firms viewed the Energy Star program as an opportunity to act on their commitments to energy efficiency and environmental protection and in the process call attention to their energy efficient products. Others viewed their decision to participate as a defensive move in response to threats by DOE to raise standards for washers under the National Appliance Energy Conservation Act of 1987. While all of the participants interviewed now believe that energy efficiency represents a customer preference, they continue to disagree over its importance relative to other needs, such as specialized cycles for different fabrics or shorter drying cycles.

DOE, with little or no consultation with industry leaders, initiated the program. The program initially created a sharp division within the industry because firms differed in their ability to create products that qualified for the label. At the time the program was proposed, none of the market leaders had announced products that could qualify for the Energy Star label. None of the U.S. market leaders had released washers that used the horizontal axis design.

Maytag began development of a horizontal axis washer in response to the 1994 DOE proposal to consider the performance of horizontal axis washers in setting the next round of

energy efficiency standards. This effort led Maytag to introduce its Neptune washer in 1997. Neptune was the first clothes washer to qualify for the Energy Star label, and sold at nearly double the price of conventional washers, largely because it led to less wear and tear on clothing. Significantly, advertisements for the Neptune washer did not mention energy efficiency prominently in the list of product features. Over the next two years, all of the other U.S. market leaders began development of clothes washers that qualified for the label. Over time, the agency has expanded the options for complying with program requirements. This has resulted in 64 models representing 20 brands qualifying for the Energy Star label.

The Energy Star Clothes Washers program has contributed to a major burst of technological innovations in the appliance industry. These improvements have allowed clothes washer manufacturers simultaneously to improve product performance, energy efficiency, and water conservation. The innovations have been driven by a combination of consumer demands for new functionality and convenience and regulatory pressure to increase energy efficiency. These improvements have created “innovation offsets” — product or process improvements resulting from environmental-performance improvements — that provide the firm with positive net returns (Porter and van der Linde 1995).

These improvements are made possible by innovations in component technologies and the rapid transformation from electromechanical to electronic controls (McHenry and Houston 2000). Electronic controls, originally found only in high-end products, have begun to migrate to mainstream products. At least four technologies — variable speed motors, digital signal processors, microcontrollers with embedded flash memory, and electronic sensors — have enabled clothes washer performance to improve while conserving water and energy.

Efficient horizontal axis washers require variable speed motors and digital signal processors to control them (Murray 2000). Variable speed motors allow washers to operate at speeds ranging from 35 rpm with intermittent pauses during tumble wash cycles to 1200 rpm during spin cycles. Increases in spin cycle speeds have allowed washers to reduce the moisture remaining in clothes at the end of wash cycle, allowing for significant reductions in the energy required to dry clothes. This improvement has also allowed manufacturers to meet customer demand for a closer match between the time required to wash a load of clothes and the longer time required to dry it.

The development of microcontrollers with embedded flash memory has created benefits for both manufacturers and consumers. Programmable microcontrollers allow manufacturers to incorporate sophisticated algorithms to control wash

cycles. Incorporating flash memory gives manufacturers the opportunity to optimize product performance during product design and to fine tune adjustments during production. Flash memory also creates the opportunity to upgrade a product by providing additional algorithms after the washer is installed in the customer’s home. This capability can potentially extend product life and provide additional value to customers by allowing them to develop customized washing cycles.

The development of electronic sensors has allowed manufacturers to fine tune washer performance in several ways (Mnif 2000). Water level sensors allow clothes washers to automatically adjust the volume of water based on the size of the laundry load. Load balance sensors are necessary to reach the higher spin cycle speeds mentioned above. These sensors detect when a load is unbalanced and adjust washer speed in order to rebalance the load before the washer shifts to very high speeds. Pressure sensors let clothes washers fine tune the amount of water used during a particular cycle. They also allow the sophisticated spray-rinse cycles necessary to make vertical axis washers energy and water efficient.

The incorporation of these electronic sensors and controls has allowed manufacturers to reduce dramatically the number of mechanical parts in clothes washers, simultaneously reducing manufacturing and repair costs. These savings have helped offset the significant investments required to build new factories and engineer radically new designs for enclosures and mechanical parts. The innovations also help pave the way toward incorporating clothes washers into home networks. The capability to control home appliances from a network is beginning to appear in high-end products and is expected to become mainstream over the next decade.

Technological innovation appears to have had significant effects on the clothes washer industry. The industry has been mature in the United States for more than a decade, with replacement of worn out washers creating the bulk of new sales (Appliance 2000). Recently, however, the volume of sales has increased, and buying patterns have begun to shift. One industry executive reported that, “people are finding reasons to upgrade their current appliances. For the first time in the history of the industry, people are buying laundry equipment to replace units that aren’t broken” (LaPat 2000). Customers are realizing that more efficient new clothes washers can save them \$90-100 per year in their energy and water bills (LaPat 2000). New buying patterns also suggest that customers believe the information about potential savings that have led them to consider operating costs along with initial purchase costs.⁷

The threat of regulation has contributed to industry decision making concerning energy efficiency throughout the life of the Energy Star Clothes Washers program. The combination of a voluntary program and regulatory development has led recently to an historic agreement on requirements for the

Table 3. Legislative and regulatory history.

1987	National Appliance Energy Conservation Act of 1987 authorizes prescriptive standards and sets initial standard.
1991	Final rule issued. DOE announces intention to accelerate review of standards.
1994	Advance Notice of Proposed Rulemaking (ANPR). DOE declares intention to consider horizontal axis washers as a feasible technology.
1996	DOE publishes final “process rule” on a stakeholder participation process for standard setting.
1998	Supplemental ANPR announces rulemaking under the process rule.
May 2000	Working group reaches agreement on proposed standard.
Oct. 2000	DOE proposes rule, based on working group agreement.
Jan. 2001	Final rule, based on working group agreement.

Energy Star label and efficiency standards among DOE, industry, energy activists, and other stakeholders. Table 3 summarizes the events leading to this agreement. Appendix 1 describes the regulatory history of the energy efficiency regulations affecting clothes washers.

Industry participants differ in their assessment of the most recent round of negotiations. While most described themselves as pleased with the outcome, others described the process as a marathon, and expressed concern that combining the negotiations over mandatory and voluntary standards strained the process.

Despite the recent agreement, the combination of energy efficiency standards and the Energy Star label has produced mixed results. Progress in actually reducing energy consumption has been relatively slow. Less efficient machines continue to account for the majority of all units sold: Six years after the initiation of the process, the great majority of washers still are not high efficiency models. Rather than driving the entire industry to change, the program has created two tiers — conventional and high efficiency — of products in the industry.

This two-tier system has positive and negative consequences. Energy efficient machines occupy the high end of the market and capture a significant price premium. Opportunities to differentiate products based in part on energy efficiency have helped spur a wide range of innovation in an industry that had previously lagged behind other sectors in innovation. Innovations at the higher end, along with publicity about the Energy Star program, have raised consumer awareness and built demand for energy efficient products. Innovations incorporated initially only in high-end products have begun to affect the design of mainstream clothes washers, and have begun to shift the entire market.

At the time of the 1994 Advance Notice of Proposed

Rulemaking, none of the major U.S. manufacturers offered high efficiency washers with performance comparable to European-made horizontal axis washers. However, by August 2000, all of the major manufacturers in the U.S. market had high efficiency models on the market or under development. Maytag, Electrolux, and General Electric all offered horizontal axis machines, and Goodman Manufacturing (Amana) reportedly had a horizontal axis machine under development. Whirlpool, the market leader, has introduced an energy efficient vertical axis machine.

Although the Clothes Washer program has created a sizable energy efficient segment, the program has not driven the less efficient models from the market. This reflects the fact that energy efficiency has not become a key purchasing criterion for the majority of consumers. In the absence of continued pressure from DOE, and requirements built into energy legislation to periodically reassess product standards, the clothes washer market might divide into two permanent tiers.

In summary, the Energy Star Clothes Washer program has stimulated technological innovation that has increased the supply of energy-efficient products. It has allowed manufacturers to differentiate energy efficient washers, allowing customers to identify energy efficient washers. Use of the label has led some of the participants to increase sales and gain favorable publicity. At least two manufacturers have found that the Energy Star product has improved their product's overall reputation for quality and reliability. High-end customers have responded favorably, encouraging other manufacturers to follow.

In combination with continuing legislative pressure to upgrade energy efficiency standards periodically, the Energy Star program appears to have begun a major market transformation. However, by the time the newly proposed standards take effect in 2004, the process will have taken more than a decade. The long product life of clothes washers ensures that a major market transformation will take many more years.

The Energy Star Office Products Program⁸

The Energy Star Office Products program illustrates the dynamics that occur when a voluntary program provokes a common response among virtually all manufacturers in an industry. The program allows manufacturers to use the Energy Star label on any office equipment that meets a level of energy efficiency specified by the program.

EPA describes the office products initiative as its flagship because it is the first and largest of the Energy Star programs (Thigpen et al. 1998). EPA initiated it in 1992 to expand markets for energy efficient goods. The objective was to publicize the cooperative efforts of industry groups, create awards to recognize superior efforts by individual firms, and

conduct extensive media campaigns to raise public awareness of the Energy Star "brand." At first, the office products segment of the program focused narrowly on computers and computer monitors. In subsequent years, it expanded to encompass printers, copiers, and multifunction devices.

This initiative was the first U.S. voluntary program focused on products. It began with a proposal from EPA that defined performance standards for computers and monitors and allowed participating firms to use EPA's Energy Star logo to differentiate program-compliant products. The program was designed "to create a market for energy efficient desktop computers, by providing a clearer market incentive for manufacturers to improve the efficiency of their products and an effective mechanism for consumers to make informed purchasing decisions" (Thigpen et al. 1998). Nearly 100% of the firms in the computer manufacturing industry have signed memoranda of understanding (MOUs) committing them to participate. In setting up the program, the Agency stated that it had attempted to:

balance the desire to set challenging specifications that maximize per unit energy savings with the desire to set specifications that allow somewhat less savings, per unit basis, but expand the overall market for energy-efficient products (EPA 1992).

In effect, the agency chose the highest level of energy efficiency that could still allow broad participation. Whether EPA expected the entire industry to enroll in the program is unclear from both published documents and interviews with agency program officers.⁹

The initial guidelines for Energy Star computers and monitors called for products to enter an energy efficient "sleep state" when not in use. These specifications were relatively easy for many manufacturers to implement because an inexpensive technology used in laptop computers was readily available from a major supplier. This solution allowed manufacturers to adapt products without major problems in either technical design or organizational coordination.

The fact that firms had failed to implement this technology before the program began reflects the limited prior demand for energy efficient office equipment. Although interviewees¹⁰ expressed support for efforts to reduce energy consumption, none felt that their customers, other than government purchasing departments and a few large clients, demonstrated any interest in energy savings as a purchasing criterion. A spokesperson for one firm indicated, however, that recent marketing data showed energy efficiency had begun to be an important purchasing criterion for its customers.

The subsequent evolution of Energy Star requirements for computers and monitors illustrates a key limitation of the program's design: EPA's attempts to develop more stringent standards for subsequent rounds have led to lengthy and oc-

asionally acrimonious negotiations with virtually all major office equipment manufacturers. Industry participants commented on the change in the collaborative stance of program managers between the agreement on the initial requirements and the last round of negotiations in 1998 and 1999.

Although none of those interviewed indicated that their companies had substantial disagreements with the original program requirements, interviewees from all but one firm — which didn't participate in the most recent negotiations — expressed concern about the increasing complexity and the adversarial character of the most recent negotiations. Some participants thought that EPA had moved away from the cooperative tone that the program had initially attempted to create.

During the negotiations, EPA invoked the possibility that the Energy Star memos of understanding might not be renewed if an appropriate agreement could not be reached. The agency also raised the specter of more stringent European regulations to persuade manufacturers to compromise on further reductions in energy consumption. In each round of negotiations, the parties eventually reached an agreement, but not without imposing substantial transaction costs on everyone involved.¹¹ Some participants felt that the program was likely to continue evolving in the future, but several commented that they might be reaching the point of diminishing returns.

The Energy Star Office Products program actively intervenes in the behavior of both manufacturers and customers. EPA approached all the leading producers of personal computers and monitors at virtually the same time. Rapid acceptance by several leading manufacturers raised the stakes for others and led many others to sign on. The initial list of 10 participating companies in September 1992 grew to more than 600, including component suppliers, by November 1998 (EPA 1998b).

The program has the potential to influence the purchasing decisions of large customers by providing them with an easy way to identify energy efficient equipment. By limiting purchases to products that comply with Energy Star guidelines, procurement managers can assure that their organizations will receive relatively energy efficient products without having to develop detailed energy use criteria. In 1993, the Energy Star programs received a significant boost from Executive Order 12845, which ordered government procurement offices to purchase Energy Star-compliant products whenever possible. The program has also made substantial efforts to encourage state and local government procurement organizations to specify office equipment bearing the Energy Star imprimatur.

These demand-side interventions have created a market for energy efficient goods. Concentrated demand has built momentum by guaranteeing manufacturers a level of sales

that justify the manufacture of energy efficient products. In fact, manufacturers can no longer afford to produce noncompliant models, with very few exceptions.

Although EPA has publicized the advantages of participating in the program, firm participation appears to have been motivated by a general desire to make improvements where the costs of doing so are not substantial and by the fear of lost revenues if it does not participate. Interviews with industry representatives confirmed the importance of potential negative consequences in motivating them to participate in the Energy Star program. Five of the six computer manufacturers interviewed said that the management of their companies believed that participating in Energy Star was a requirement if they wanted to continue doing business with units of government. Some also mentioned that their large corporate customers also required it. An interviewee from the sixth manufacturer said that the decision was straightforward for her firm because it had already developed a technology that would meet the requirement.

The program works, in part, because it prevents having participants' prices undercut by nonparticipating manufacturers. Otherwise, in the very competitive markets for office products, any manufacturer that raised prices to pay for energy efficiency enhancement would be at a competitive disadvantage relative to those who left energy consumption unchanged. Few firms would choose to improve energy efficiency unilaterally, especially considering the low priority that customers have traditionally placed on it.

The threat of regulation was not a factor in the Energy Star Office Products program. EPA does not have legislative authority to develop energy efficiency standards for office products. However, the threat of sanctions was very real. Firms that failed to develop Energy Star-compliant products would be unable to sell to the federal government, and probably could not sell products to large customers and energy conscious consumers. Facing fierce competition, virtually all firms in the industry joined the program.

This experience illustrates a hazard inherent in voluntary initiatives that produce a collective response — the difficulty of making standards more stringent than their initial levels. The program focused initially on a readily achievable source of energy savings, energy consumption while the computer or monitor is idle. Recently, the program has begun to address the issue of energy consumption when the devices are in use. This would require more extensive technical change, for example incorporating technology that shifts individual components of a computer such as hard disc drives to energy-saving states when not in use. Proposals to tighten the requirements for program participation met initial resistance because participating firms differed in their ability to implement these additional measures.

In summary, the EPA's Energy Star Office Products initiative quickly enlisted virtually all manufacturers in the industry in a voluntary program to reach a level of performance that was feasible for most if not all manufacturers of computers and monitors. Most participants complied; utilizing a previously existing technical solution they had no prior incentive to implement. After calculating the benefits and costs of participating, these firms used the Energy Star label to signal the energy efficiency of their products to customers. Subsequent negotiations to raise the standards for participation required negotiations and compromises among participating firms, and between participating firms and the agency. However, the overall result has been a significant level of energy savings, along with periodic increases in energy efficiency achieved by the entire industry.

Separating and Converging Mechanisms

The Energy Star programs for office products and clothes washers illustrate the dynamics of separating and converging mechanisms in voluntary programs. The Clothes Washer program is an example of a separating mechanism, one that drives firms to behave differently from their competitors (Rothschild and Stiglitz 1976). Such a mechanism enables individual firms with superior environmental performance to differentiate themselves from others. Separating mechanisms may focus on the performance of a firm's operations or the environmental impact of its products, or both.

Separating mechanisms in voluntary initiatives include programs managed by non-government organizations (NGOs), governments, and standards organizations. For example, product eco-labeling programs such as the Blue Angel and Green Cross labels recognize products with superior environmental performance. The Coalition for Environmentally Responsible Economies (CERES) — an NGO — has created a program that asks firms to commit to a stringent code of practices and provide detailed reports on their accomplishments.¹² Separating mechanisms also include U.S. government programs, such as Climate Wise, Green Lights, and Performance Track which give recognition to firms that adopt energy efficient technologies or improvements in environmental performance.

Figure 2 illustrates the development of a separating mechanism: The "initiating party" proposes a voluntary program to identify firms that are outstanding in a particular dimension of environmental performance. The initiating party announces the program to the target audience(s) and the general public. Firms then decide whether to participate in the program or not, based in part on their estimate of the response from targeted audiences. Target audiences, in turn, decide whether to reward firms that choose to participate, to

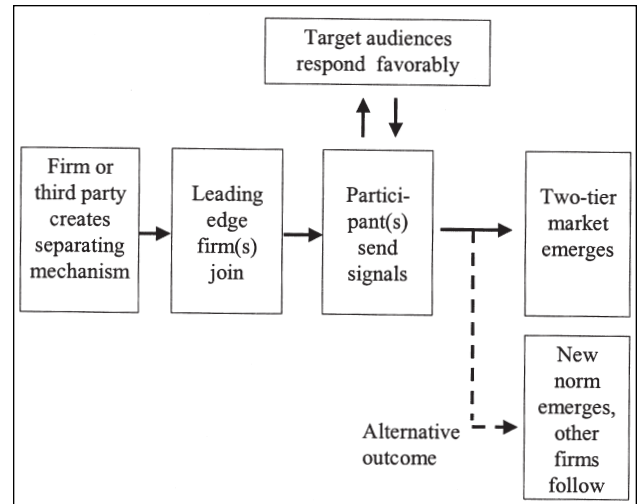


Figure 2. Development of a separating mechanism.

sanction firms that choose not to participate, or to ignore the program altogether. A separating mechanism may create customer or stakeholder expectations that drive trailing firms to follow the leaders in improving environmental performance or energy efficiency.

The Energy Star Office Products program is an example of a converging mechanism, one that leads all targeted firms to adopt a desired behavior. Such approaches tend to impose less ambitious requirements than separating mechanisms, at least initially, because standards must be achievable for all firms in the targeted group.

Converging mechanisms produce significant results by stimulating all firms in a given industry to participate. This approach is relatively simple in concept, as shown in Figure 3. Typically the initiating government group, NGO, or standards organization proposes a voluntary improvement in the environmental performance of the target population. The initiating party contacts the target population — all firms within an industry. All parties then negotiate the requirements and, if agreement can be reached, the entire group commits to them.

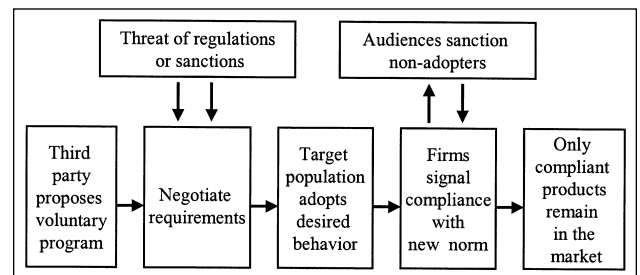


Figure 3. Development of a converging mechanism.

The persuasive power of a converging mechanism is that no firm stands to gain competitive advantage from participating, but that firms may be put at a disadvantage by refusing to participate. Such a strategy relies more heavily on sanctions than rewards in influencing corporate decision-making.

The effectiveness of a converging mechanism depends, in part, on assuring that customers or other stakeholders actually deliver the expected rewards or sanctions. In practice, the most effective sanctions associated with a converging mechanism are often indirect. A company is at risk if it is the only firm or the most visible firm in the target population that does not participate. This threat is difficult to evaluate quantitatively, but can lead to a significant loss of general reputation, potential loss of revenues and market share, and sometimes decreased stock price. In many instances, the nature and likelihood of sanctions may be difficult to assess precisely. This uncertainty concerning sanctions creates the possibility of strategic behaviors by both the initiators and the target population.

The two programs discussed in this paper may not be entirely representative of their respective mechanism types. The Office Products program developed an industry-wide transformation without a significant threat of regulation. The Clothes Washer program made creative use of a very real threat of regulations, and a cooperative rule-making process that has started an evolution toward a converging mechanism. These complexities suggest that converging and separating mechanisms may represent ends of a theoretical spectrum rather than mutually exclusive types.

Conclusions and Policy Implications

The Energy Star programs for clothes washers and office products have created incentives for manufacturers to improve the energy efficiency of their products beyond legal requirements. Both programs illustrate the potential for voluntary public policies to address opportunities for energy effi-

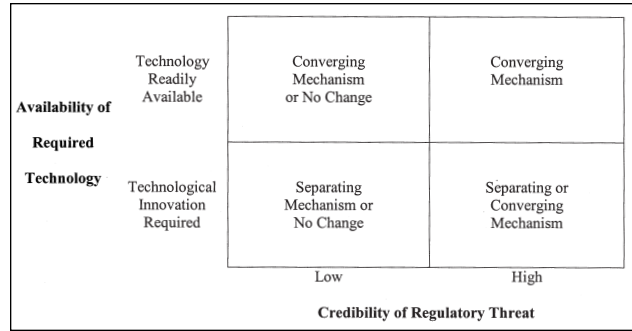


Figure 4. Conditions favoring each mechanism.

ciencies that market processes have failed to address. Both programs have been successful both in the percentage of the industry choosing to participate and the energy and cost savings achieved.

These successes were achieved through two different mechanisms — separating and converging mechanisms — reflecting factors in the nature of and market for the products targeted. As shown in Table 4 these two mechanisms diverge dramatically in the way that they drive change; in the requirements that they impose on participants; and in the circumstances in which they can be employed. Yet both have led to significant energy savings and have instigated major market transformations.

This study does not provide conclusive evidence of the conditions in which each mechanism is most appropriate. However, a few observations may be in order. Figure 4 illustrates two variables affecting the type of mechanism that is likely to develop for any particular industry.

One key variable is the availability of technology to increase energy efficiency. If the technology is readily available, its adoption provides little opportunity for any individual firm to gain competitive advantage relative to its competitors by adopting it. If a single firm is successful in selling products using the readily available technology, other

Table 4. Comparison of separating and converging mechanisms.

Attributes	Separating Mechanism	Converging Mechanism
Primary impact on market	Harness demand for greener products.	Intervene directly in the supply of all products in the same category. Prevent less energy efficient products from undercutting prices.
Primary “levers”	Reward leaders by increasing sales of their products.	Sanction non-participants; or impose regulation if agreement isn’t reached.
Change model	Create incentives for followers to catch up.	Move entire group forward in negotiated steps.
Requirements for success	Ability for firms to differentiate their products.	Compelling reason to cooperate, such as threat of regulation or sanctions.
Strengths	Can create competitive advantage for leaders, can provoke competition based on improved environmental characteristics.	Can improve entire industry’s performance.
Pitfalls	Can have limited influence on firms that can’t qualify.	Can produce least common denominator, can be less ambitious than regulations.

firms can quickly follow suit. As a result, readily available technology favors converging mechanisms if firms face compelling motivation to adopt the technology.

If no technology is readily available to increase energy efficiency in a product category, then technological innovation will be required. Firms will face little incentive to invest in the required innovation unless they are able to A) create and sell differentiated products resulting from the technology, or B) license the technology to competitors. As a result, a requirement for technological innovation may favor a separating mechanism. However, if firms face compelling motivation to adopt the technology, the option for an innovator to license technology to other firms may make a converging mechanism possible.

A second variable affecting the type of mechanism that may develop is the credibility of regulatory threats. If the likelihood of regulatory action is high, firms face a strong incentive to preempt regulation by adopting a voluntary standard. Under these circumstances, a converging mechanism is likely, provided that industry participants, regulators or (ideally) both have the skills to negotiate a common response.

If the likelihood of regulation is low, a separating mechanism is more likely, unless public policies such as government procurement policies can provide a strong motivation for companies to adopt energy efficiency features.

The results from the two industries in this study illustrate the complex effects of these two variables. The computer industry faced no credible threat of regulation, but had a readily available technology that most industry participants could adopt. The U.S. government helped provide an incentive for companies to adopt the technology by using Federal purchasing guidelines to create a strong market pull to compensate for the lack of a regulatory threat. The result was a converging mechanism that enlisted the participation of virtually the entire industry.

The clothes washer industry experienced a more complex evolution. The industry required technological innovation to achieve significant increases in energy efficiency.¹³ In the absence of any policy intervention none of the industry leaders in the mature U.S. industry had chosen to invest in energy efficient technology development. DOE heightened industry interest by making an explicit and credible regulatory threat, by announcing its intention to base future regulations on the more energy efficient European horizontal axis technology. DOE followed its regulatory threat with the announcement of the Energy Star program for clothes washers as an opportunity for leading edge firms to differentiate their products, and potentially to avoid more stringent regulation. The result initially was a separating mechanism.

Subsequent "stakeholder dialogues led to an agreement that raised the energy efficiency of all models after 2004 to

the levels specified by the original Energy Star voluntary requirements. The subsequent stage has effectively created a converging mechanism.

The success of these two programs illustrates the potential power of voluntary product labeling programs. Additional research is necessary to identify the factors that determine whether separating and converging mechanisms will be most effective for a particular industry, and to determine the most appropriate mix of policy instruments required to make either mechanism effective in a particular industry. Carefully designed product labeling programs may open up a powerful new category of public policies that succeed by altering the relationships between manufacturers and customers in mutually beneficial ways.

Endnotes

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2. The phrase "market transformation" is widely used in energy efficiency literature, but does not appear to have a consistent definition. In this paper, the phrase refers to conversion of a large percentage of a market to more energy efficient products in response to an intervention.
3. To protect their anonymity, the industry interviewees are not cited. All comments attributed to individual firms are taken from published sources.
4. Rothschild and Stiglitz refer to the outcomes as "equilibria." This study refers to the outcomes as "mechanisms" to allow for the possibility of outcomes that are not stable equilibria. Although application of the term is new in this study, converging mechanisms have been common in voluntary environmental initiatives.
5. I gratefully acknowledge an unidentified participant at the Association for Public Policy and Management (APPAM) conference in Seattle, Washington, November 3, 2000 for calling my attention to this distinction.
6. Cost savings estimates for both industries are expressed in 1998 dollars.
7. Investigation of consumer decision-making processes is outside the scope of the current study. Detailed investigation of the changes in customer response to energy efficiency information could provide significant insights into the effectiveness of voluntary initiatives such as the Energy Star Washing Machine program.
8. This section builds on the analysis presented in Howarth et al. 2000.
9. Subsequent Energy Star programs for televisions, video-cassette recorders and stereos attempted explicitly to enlist the participation of their entire industries (Sylvan 1999).
10. Industry interviews conducted by the author in 2001 included more than 55% of the U.S. desktop computer industry by domestic market share (five interviews and one written response to questions).
11. Discussion was quite heated at one negotiating session observed by the author. Industry participants indicated during informal discus-

sions that the negotiation process had strained their relations with the EPA program management team.

12. Committing to the CERES principles is both a signal and a formal commitment to a "reporting" mechanism in which participants provided detailed information.
13. The response by the clothes washer industry included a range of technological approaches. Some firms adapted the horizontal axis technology already commercialized by European manufacturers to meet American consumers' needs. Others chose to develop new technologies to achieve increases in water and energy efficiency.

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Appendix

Development of the Energy Star Clothes Washer Program

The National Appliance Energy Conservation Act of 1987, which amended the Energy Policy and Conservation

Act, imposed standards for clothes washers as part of a larger program of energy conservation requirements for consumer products. Initial levels were relatively modest, requiring only that clothes washers manufactured on or after January 1, 1988 have an unheated rinse option. The 1987 Act required the DOE to decide by January 1, 1990 whether this standard needed to be amended. The rule, issued on May 14, 1991, took effect three years later (56 FR 22279).

In the 1991 rule, DOE spokesmen announced plans to accelerate the second review of energy efficiency standards for clothes washers because the department had become aware, after the rulemaking was closed, of the “horizontal axis” design used in Europe that had not been considered during the rulemaking. On Nov. 14, 1994 DOE issued an Advance Notice of Proposed Rulemaking (ANPR) that began the second review of energy efficiency standards for clothes washers, dishwashers, and clothes dryers. DOE presented the technologies to be considered and the product classes they planned to analyze along with the analytical framework and models to be used in performing analyses. The Federal Register notice specified DOE’s intention to consider horizontal axis washers as one of the feasible technologies.

In 1996, however, Congress required DOE to revise its standard-setting process to include stakeholder participation. In 1996, DOE published the final rule called “Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products,” which became known as the “process rule.” In 1998, DOE issued a Supplemental ANPR, beginning the first rulemaking under the process rule. The

new notice presented the product classes to be analyzed, the analytical framework, and preliminary analyses of lifecycle cost, payback and national energy savings.

DOE convened a series of meetings between manufacturers, energy groups, and other stakeholders beginning in 1996 and continuing until May 2000. In May 2000, the working group reached agreement on a proposed standard. DOE responded favorably to the proposal and in October endorsed it with minor modifications in a proposed rule that recognized the joint stakeholders’ proposed standards to be “technically feasible and economically justified.” The final rule, 66FR3314, was published in January 2001.

The joint stakeholders agreement included four provisions relevant to clothes washers. First, it created new energy standards based on “modified energy factors” (MEFs) to take effect in 2004 and 2007. Second, it set new MEFs for machines to use in qualifying for the Energy Star program. Third, it provided tax credits for the production of energy efficient clothes washers as well as refrigerators and freezers. The tax credit will create two energy efficiency standards. A firm will receive \$50 per unit that reaches the first level, and \$100 for each unit that reaches the second level, up to \$30 million per company per level.

Finally, the new rule included an agreement for firms to disclose voluntarily the water usage factors for each model that meets the Energy Star standards, beginning in 2001. The new Energy Star standard provides an initial 22% reduction in energy consumption over the current standard by January 1, 2004, and a 35% reduction by January 1, 2007.