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Incentives and Patterns of Joining the U.S. EPA ENERGY STAR® Program

A Group Project submitted in partial satisfaction of the requirements for the degree of
Master's in Environmental Science and Management
for the
Donald Bren School of Environmental Science & Management

by

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The mission of the Donald Bren School of Environmental Science & Management is to produce professionals with unrivalled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention and remedy of the environmental problems of today and the future. A guiding principal of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions.

The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) program. It is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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Abstract

ENERGY STAR® is a public-private partnership program which aims at promoting energy efficiency and conservation. Due to the voluntary nature of the program and the likely involved cost to the firm, it is important to understand what motivates a firm to join. To date, limited empirical data are available about these motivations. This study examines firms' incentives for joining ENERGY STAR and how these impact the rate of joining. Our results, based on a survey representing 29 percent of 573 manufacturers participating in ENERGY STAR, show that firms' primary incentive when joining the program is to improve their environmental reputation. Increasing market share and helping managers to promote the adoption of energy-efficient products within the firm are identified as other significant motivations. Additionally, this study compares the rate at which firms join ENERGY STAR based on firms' characteristics and their stated motivations. The following factors were found to result in an earlier joining date: consideration of the quality and characteristics of current program participants; larger firm size; and geographical proximity to Environmental Protection Agency (EPA) and Department of Energy (DOE) headquarters. Conversely, if firms joined the program primarily to increase the distribution of products or number of government contracts, they would join the program later as these incentives were introduced after the onset of the ENERGY STAR program. The overall results indicate that firms participating in ENERGY STAR not only provide a public good by reducing energy use but are also motivated by private benefits. Based on these conclusions and considering tightened government budgets, we recommend that the EPA and DOE promote the leaders in each product category to effectively increase participation and accelerate the rate at which firms join ENERGY STAR.

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1.0 Introduction

Climate change, poor air quality, acid rain, and toxic pollutants are results of industrial development all caused by the need for energy. The generation of energy and the use of fossil fuels have devastating effects on our natural environment, and hence our quality of life. The stalled ratification of the Kyoto Protocol has spurred national versus international development of energy conservation programs. Energy conservation promoted by the U.S. government is only seen in a handful of voluntary programs but is recently receiving more attention with the promotion of "Change," a new public awareness campaign for the ENERGY STAR® program.

ENERGY STAR is a partnership between product manufacturers, local utilities, retailers, the U.S. Environmental Protection Agency (EPA), and the Department of Energy (DOE). This partnership promotes the manufacture of energy-efficient products by labeling them with the ENERGY STAR logo and educating consumers on energy-efficiency. The objective of the program is to promote the use of energy-efficient products, thus reducing the demand for and supply of energy and enhancing quality of life.

Much research has been conducted on the energy savings associated with ENERGY STAR but little has been done on the incentives and characteristics that make a firm more likely to join voluntary environmental programs (DeCanio 1998, EESI 1999, EPA 2000, Webber and Brown 1998, Webber et al. 1999). The successful administration and development of environmental programs should be based on a sound understanding of the inherent characteristics and incentives that motivate firms. The objectives of our research are to identify the incentives leading to a firm's decision to join ENERGY STAR

and the factors that may influence the timing of joining. This will provide a foundation to the EPA and DOE for better management of current, and development of future, environmental policies.

To meet these goals, we begin with a brief background on ENERGY STAR and provide detailed definitions of our objectives and subsequent hypotheses. Next, we describe how the data necessary for analysis were obtained through a questionnaire sent to 600 current ENERGY STAR partners. Finally, the results and recommendations based on our findings are presented.

2.0 Description of the ENERGY STAR® Program

The ENERGY STAR® program began in June 1992 with the labeling of personal computers and monitors. There are currently 33 product categories including printers, facsimile machines, photocopiers, transformers, exit signs, boilers, appliances, televisions, video cassette recorders, digital video disk (DVD) players, home audio equipment, windows, lighting fixtures and compact fluorescent bulbs, traffic signals, dehumidifiers, and roofing products. Appendix A presents an example of the Memorandum of Understanding (MOU) between the EPA/DOE and the partners.

Currently, the EPA has awarded the ENERGY STAR label to over 11,000 products with more than 1,600 manufacturers participating in the ENERGY STAR program (EPA, 2002). In 2000 alone, more than 120 million ENERGY STAR products were purchased (Laitner and Sullivan, 2001). The numbers of labeled products and participating manufacturers continue to increase. The ENERGY STAR program was originally designed for product manufacturers alone but currently, the program includes ENERGY STAR for Small Businesses, ENERGY STAR for Schools, and ENERGY STAR Buildings. These programs do not necessarily target the manufacture of energy-efficient products but instead encourage the use of energy-efficient products.

According to the EPA, the goals of ENERGY STAR are to:

- *Foster public-private partnerships* by expanding the market for energy-efficient products and reducing energy waste;
- *Reduce air pollution* which can lead to climate change and urban smog;

- *Recognize the most energy-efficient product models in the market* by granting the use of the ENERGY STAR label;
- *Maintain customer satisfaction* and ensure performance is not sacrificed for energy-efficiency;
- *Encourage innovation and competition* (Fanara, 1999).

The ENERGY STAR program partners with manufacturers in the product categories to develop guidelines and to determine which of their products qualify for the ENERGY STAR label. The program encourages manufacturers to produce energy-efficient equipment they otherwise might not. Currently, ENERGY STAR products exceed existing federal efficiency standards by anywhere from 10 to 27 percent (EPA, 2002). In order to receive an ENERGY STAR label, the product must: demonstrate a significant energy-savings potential, have cost-effective and non-proprietary efficiency, maintain or enhance performance of the product, have feasible differentiation and testing, and demonstrate that labeling would be effective in the market (Fanara, 1999).

It is estimated that more than 40 percent of the American public recognizes the ENERGY STAR logo (Laitner and Sullivan, 2001). The logo influences the purchasing decision of energy-conscious consumers by identifying office equipment, home appliances, and other products that save energy and money while protecting the environment. Appendix B presents an example of ENERGY STAR monetary and pollution savings possibilities for photocopiers. The program provides a simple criterion for specifying energy-efficient products without having to develop detailed energy-use criteria. In 1993, these programs received a significant boost from Executive Order

12845 (signed on April 21), which ordered government procurement offices to purchase "computers, monitors, and printers [that] meet 'EPA ENERGY STAR' requirements for energy efficiency." Executive Order 13123 (signed on June 8, 1999) further promoted energy efficiency by ordering government agencies to purchase ENERGY STAR compliant products for all "energy-using products" whenever possible.

According to the Environmental and Energy Study Institute (EESI) between 1991 and 1999, the ENERGY STAR program reduced carbon dioxide emissions by 260 million metric tons and nitrogen oxides emissions by 150,000 tons. Additionally, EESI (1999) estimated that the purchase of ENERGY STAR products resulted in over $7 billion in energy bill savings. However, the benefits of the ENERGY STAR program encompass more than just reductions in greenhouse gas emissions and monetary savings. Increasing energy efficiency through programs such as ENERGY STAR, in turn, results in the extraction of fewer natural resources to fuel power plants, and better local air quality nearer to generating facilities.

Although there are potential environmental benefits for society, these benefits alone may not be sufficient to motivate firms to participate in such a voluntary program considering the likely associated costs. Our study aims to identify the private benefits of participating in a voluntary program as well as the underlying rate of joining. After a description of the actual pattern of joining in Section 3.0, firms' motivations to participate in the program will be discussed in Section 4.0.

3.0 Patterns of Joining the ENERGY STAR® Program

The pattern of change of the cumulative number of joiners into a program over time is equivalent to the term 'diffusion', commonly used in the literature. According to Strang and Soule (1998) "Diffusion is the spread of something within a social system." The term 'spread' implies flow or movement from a source to an adopter via communication or enforcement. This section assesses the nature of diffusion, its speed, and how this speed is measured. A further analysis on what qualitatively affects diffusion can be found in Appendix C.

3.1 The Diffusion Curve

A diffusion curve, for our purposes, is a graph of the cumulative number of joiners plotted against time for a particular product category or overall. In order to study the nature and the characteristics of the diffusion of the ENERGY STAR® program into various industries - since 1992 - diffusion curves were created. Four diffusion curves were constructed - for the roofing product category, the lighting fixtures and exit signs product categories, the office equipment product category, and one overall combining all product categories.[1]

[1] These three product categories were selected because they were the only ones we obtained sufficient data for. The attainment of the data is discussed thoroughly in Section 5.

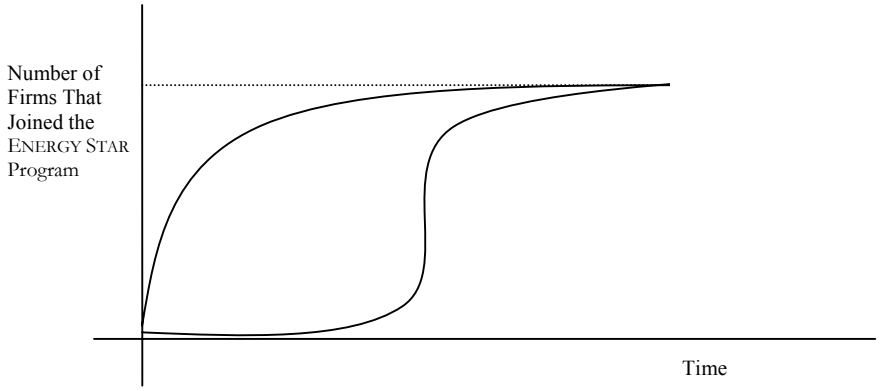


Figure 1: Possible Shapes of the Diffusion Curve

Typical forms of the diffusion curve are either exponential or S-shaped, as shown in Figure 1. Due to the fact that as time goes by, the number of joiners converges to the total number of joiners (or in other words the first derivative of the curve converges to zero), all the other possible shapes are sub-cases of these two patterns and can therefore be well approximated by the two curves presented above.

According to literature, an S-shaped diffusion curve is more common in industrial innovation (Mansfield 1968, Stoneman 1981, Jovanovich and Lach 1989, Kline and Jordan 2001, Gavious and Mizrahi 2001). Various models have been created in order to depict how an innovation diffuses, given that the relative market is efficient and perfectly competitive (e.g. there are no monopolies or oligopolies regarding a specific product). Almost all of the models conclude that the diffusion of an innovation, regardless of whether that innovation is administrative (e.g. involves a decision regarding the restructuring of the firm's administration methods or of its production line and market goals, such as joining the ENERGY STAR program) or non-administrative (the

very purchase of an energy-efficient product instead of the purchase of a less energy-efficient product), is depicted by an S-shaped curve.

3.2 Construction of Diffusion Curves

This study entails a group of participants who joined on a variety of dates from the beginning of the program until the end of 2001. In order to construct the overall diffusion curve for all the product categories in this study, the time period from 1/1/1993, when the program started, until 12/31/2001, the last year within which the last firm joined ended (for the purposes of this study), was divided into six-month intervals. At the end of that interval, the number of firms that have already joined is recorded. Given the lack of precision regarding the joining date, which could not be exactly recalled by a certain fraction of the respondents, we feel that this interval was short enough to allow us to account for time as a continuous variable. Therefore, the value of time (t) in the equations below is the distance from the day the program started until the day a firm joins, in **days**. This time-distance constitutes the independent variable in the following models.

Let then a_i be the number of firms who join in the i^{th} semester. Let there also be A_k, the number of firms who joined from 1/1/1993 until the end of the k^{th} semester. k can also be interpreted as the "date k;" for example k=2, or "date 2" is 7/1/1993. For our analysis, the independent variable, time, on the x-axis is listed in the month/day/year format versus the "date k" format. Therefore, the following relationship holds: $A_k = \sum_{i=1}^{k} a_i$ for k=1,2,3…19. After the formation of those (k, A_k) points, the best possible curve will be fit. The same method holds for the construction of the diffusion

curves for each individual product category, adjusting for the starting and the ending date of the program respectively.

As mentioned before, the curve will be either exponential or S-shaped. The general form of the exponential curve to fit is $f(t) = G_T - e^{c-st}$ and the general form of the S-shaped curve is $f(t) = \frac{G_T}{1+e^{c-st}}$, where G_T is the total number of joiners, *f(t)* is the cumulative number of joiners by time *t*, *c* and *s* are parameters to be determined and *s* is a positive number. The R^2 of the respective curves, determined after the linearization of the models, determines which of the two possible curves fit the best. The speed (i.e. strength) of diffusion is represented by the value of *s*. The larger the value of *s*, the stronger the diffusion. The intuition behind this is that the larger the *s*, the faster the exponential factor converges to zero and therefore the faster the entire fraction converges to G_T.

3.2.1 Diffusion Within Product Categories

We first looked at the diffusion within product categories. The diffusion patterns within each product category are demonstrated in the following graphs. Joining dates from the EPA were available for the office equipment product categories only (photocopiers, facsimile machines, mailing machines, computers, monitors, scanners, and multifunction devices). The graph in Figure 2 was constructed using this data, as opposed to the data obtained from our survey that were used to construct the remaining diffusion curves.

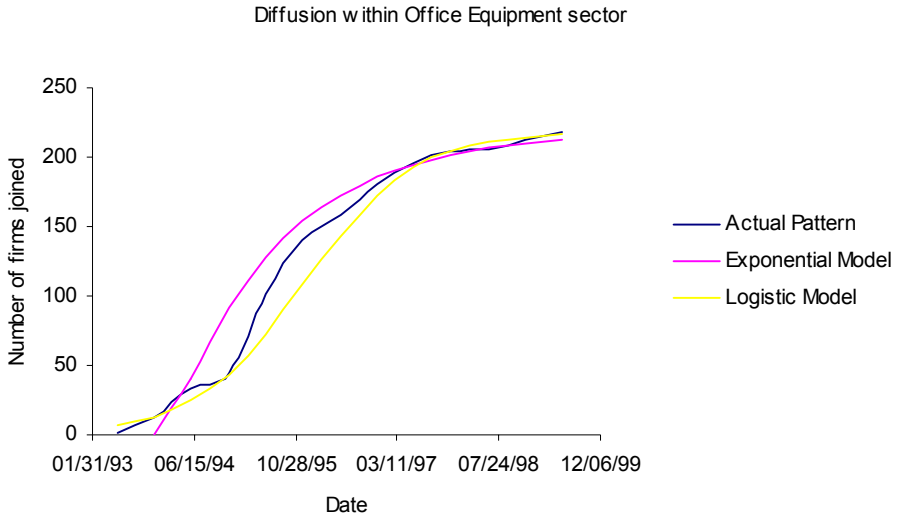


Figure 2: The Diffusion Curve of the ENERGY STAR Partners in the Office Equipment Product Categories

From the diffusion curves computed and plotted in the figure above, it is not quite clear which diffusion model fits best. After inspecting the R^2 value as seen in Table 1, the conclusion is that the two models are practically equally powerful.

	Parameter c	Parameter s	Relationship	R^2
Exponential	5.8560	0.0019	$f(t) = G_T - e^{5.8560-0.0019t}$	0.9592
Logistic	3.4341	0.0037	$f(t) = \frac{G_T}{1+e^{3.4341-0.0037t}}$	0.9547

Table 1: Quality of Fit of the Two Diffusion Models With Respect to the Office Equipment Product Categories

As can be seen in Figure 2, there is a steep increase in joining 300 days (10 months) after the initiation of the program for this category (June 1992). This may be attributed to the issuance of Executive Order 12845 (signed on April 21 1993).

Significant data on the joining dates of firms were received from our questionnaire only for lighting fixtures, exit signs, and roofing product categories. Figure 3 demonstrates the diffusion pattern within the lighting fixtures and exit signs product categories. Since both lighting fixtures and exit signs are similar in their North American Industry Classification System (NAICS) codes, we grouped them together for the following figure.

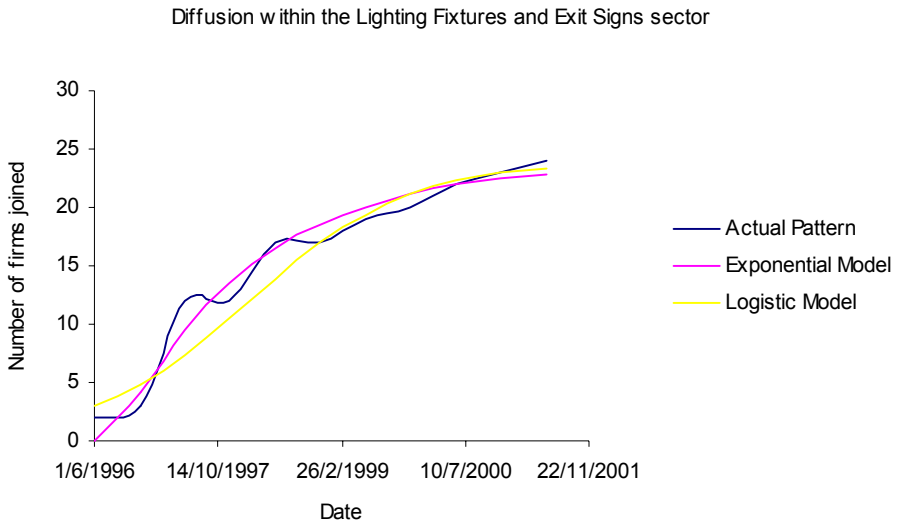


Figure 3: The Diffusion Curve of the ENERGY STAR Partners in Lighting Fixtures and Exit Signs

The quality of the fit of each model is demonstrated in Table 2:

	Parameter c	Parameter s	Relationship	R^2
Exponential	3.3143	0.0018	$f(t) = G_T - e^{3.3143-0.0018t}$	0.9574
Logistic	1.9254	0.0031	$f(t) = \frac{G_T}{1+e^{1.9254-0.0031t}}$	0.9507

Table 2: The Quality of Fit of the Two Diffusion Models in Lighting Fixtures and Exit Signs

As in the case of the office equipment product categories, it is rather clear that both models are equally powerful. Both R^2 values are very high, implying that the predicting power is the same regardless of the model finally chosen.

Figure 4 demonstrates the diffusion pattern for the roofing product category.

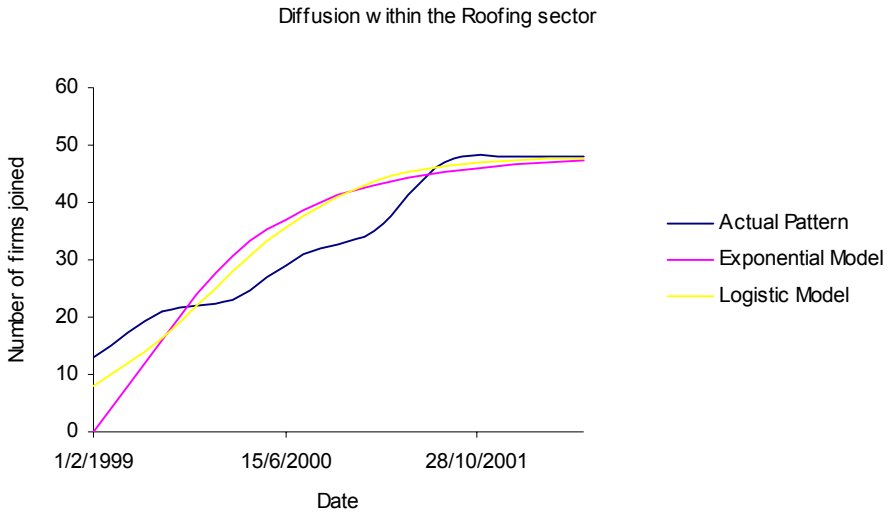


Figure 4: The Diffusion Curve of the ENERGY STAR Partners in the Roofing Product Category

Both models seem to be fair predictors of the diffusion in the roofing product category as well. Therefore, a closer inspection in their R^2 values, as represented in Table 3 is necessary.

	Parameter c	Parameter s	Relationship	R^2
Exponential	4.0686	0.0033	$f(t) = G_T - e^{4.0686-0.0033t}$	0.8433
Logistic	1.6190	0.0054	$f(t) = \frac{G_T}{1+e^{1.6190-0.0054t}}$	0.9076

Table 3: Quality of Fit of the Two Diffusion Models With Respect to the Roofing Product Category

From the quality of fit of the two models, it is clearly seen that the logistic model is a better predictor since it features a higher R^2, by almost 6.5 percent.

The overall impression is that the logistic model is a better predictor of the pattern of diffusion in each product category, as the literature suggests. We focused our analysis on the specific product categories because they are the only ones that we obtained adequate amount of data for from our questionnaire or the EPA. For the remaining product categories, such an elaborate analysis was impossible. Therefore, we developed the following figure, which demonstrates how the program diffuses across all product categories individually. Even though this graph cannot serve as a proxy for any diffusion pattern across each product category, it is the basis for the overall diffusion curve that is presented in the following section.

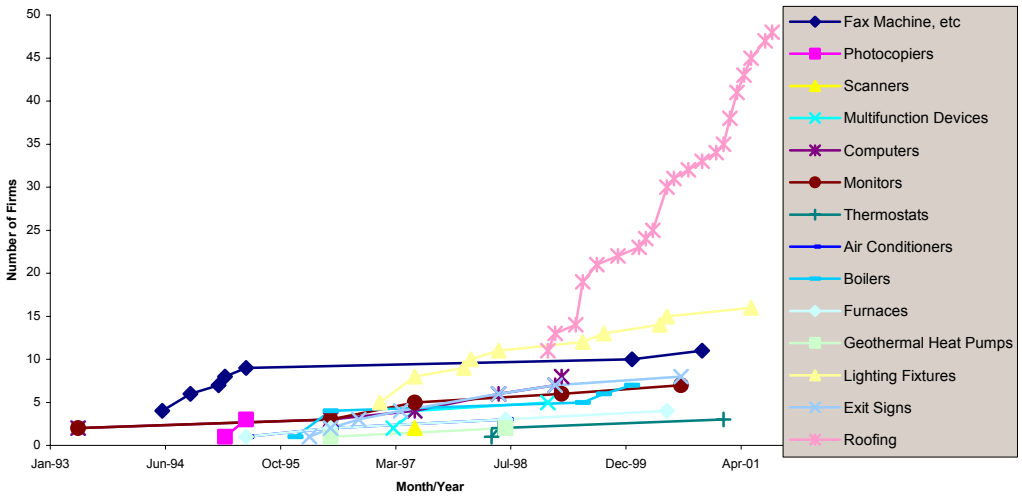


Figure 5: Diffusion of Product Category Joining Dates

Figure 5 shows that diffusion across product categories has fast rates of joining in early years of the program and then the rate levels off to zero. This holds true for all product categories except roofing and lighting fixtures, whose rates are steeper. We thought it would be interesting to observe what happens when we combine all product categories to get an overall diffusion curve.

3.3 Diffusion of the ENERGY STAR Program

After examining diffusion for each individual product category, the analysis of the overall diffusion follows as shown in Figure 6. The product categories are listed in the boxes while the line joining the boxes to the x-axis depicts the approximate date the program was initiated.

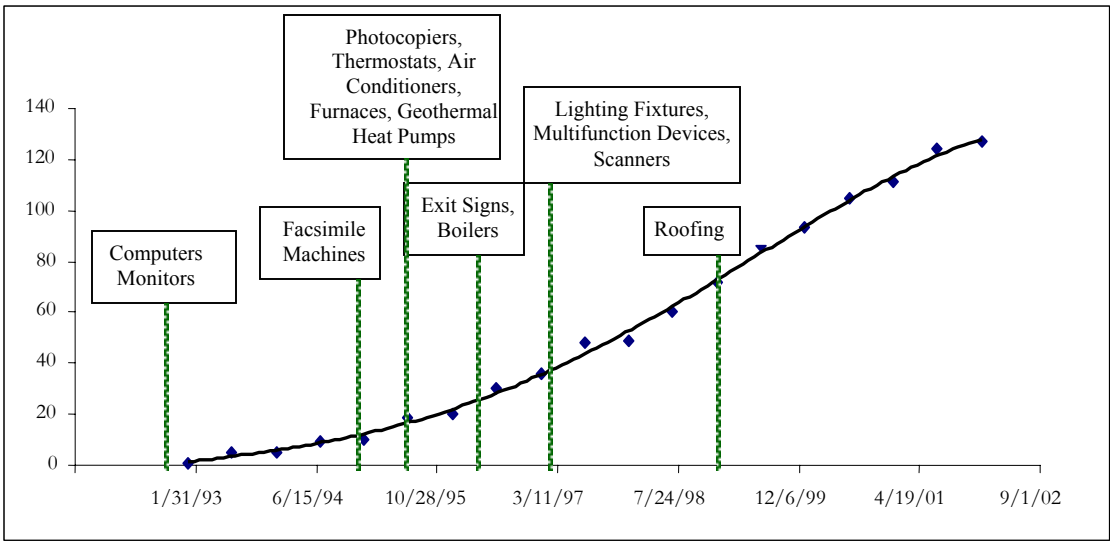


Figure 6: The Diffusion Curve of the ENERGY STAR Program

This overall diffusion curve is close to being a straight line, meaning that the rate of joining is close to constant. That could be attributed to the EPA's limited resources. The agency could be trying to "smooth out" the diffusion by not making the choice of joining available to every product category at the same time, thus eliminating the possibility of congestion within the agency.

How well each model fits the data is demonstrated in Table 4:

	Parameter c	Parameter s	Relationship	R^2
Exponential	5.3775	0.0008	$f(t) = G_T - e^{5.3775-0.0008t}$	0.7036
Logistic	4.6064	0.0027	$f(t) = \frac{G_T}{1+e^{4.0273-0.0021t}}$	0.9560

Table 4: Quality of Fit of the Two Diffusion Models With Respect to the Entire Number of Firms Joined

As the literature review suggests, the logistic model better expresses the diffusion and it provides greater predicting power than the exponential counterpart, as was the case for individual product categories. The R^2 of the exponential model is inferior by almost 26 percent.

The dates of joining follow the gamma distribution with shape parameter $k = 0.75$. The mean of the sample is 19.4 months, implying that on average, firms join 19.4 months after the option of joining was made available to them. The standard deviation is 22.4, not much greater than the mean, showing that few firms join later or earlier than that point in time.

3.3.1 Speed of Diffusion

Since the logistic model admittedly better predicts the diffusion process than its exponential counterpart, its parameters can be more useful measures of the speed of the diffusion of ENERGY STAR within each product category and overall.

The important parameter that determines the speed of diffusion in the logistic model is the s parameter. As explained above, the higher the s parameter, the faster the diffusion. The findings with respect to the s parameter are presented in the following table.

	s parameter
Overall	0.0027
Office Equipment Product Categories	0.0037
Lighting Fixtures and Exit Signs Product Categories	0.0031
Roofing Product Category	0.0054

Table 5: *S* Parameters for Each Diffusion Curve in Respect to the Logistic Model

Table 5 shows that the overall diffusion of the program has a slower pace than the diffusion in each individual product category. As already explained, this was expected due to possible administrative choices by the EPA. As far as individual product categories are concerned, roofers seem to be the most responsive since they join faster than firms in other categories. Interesting questions arise on what characteristics affect the timing of joining from the diffusion of the program. These led us to the development of our primary objectives.

4.0 Research Objectives and Hypotheses

4.1 Research Objectives

The primary objectives of our research are to evaluate what the most important factors are that motivate firms to participate in ENERGY STAR® and what differentiates firms that join early from those that join later.

In order to approach these objectives, we first discuss the motivations of firms for joining the program. Secondly, we develop hypotheses pertaining to the characteristics that affect the timing of an individual firm's decision to join the program after the inception of the program for the specific product category.

4.2 Why Firms Join ENERGY STAR

Environmental collaborations between the U.S. government and private industry are an exchange of efforts potentially beneficial to both parties. Voluntary agreements aid in redefining the authority of the government over firms from coercive to cooperative (Delmas and Terlaak, 2001). Additionally, research conducted by the DOE has found that voluntary programs can be extremely successful at spurring change and encouraging participants to incorporate environmental philosophies into their management practices (Dowd, 2000).

A case study by Howarth et al. (2000) reveals that there are numerous benefits firms can get by joining voluntary programs, such as a positive effect on profits or an increase in market share. Literature and studies conducted by Cavaliere (2000), DeCanio (1998), DeCanio and Watkins (1998), Henriques and Sadorsky (1996), Howarth, Haddad, and Paton (2000), Laitner and Sullivan (2001), Paton (2000), and Videras and Alberini (2000) have evaluated and suggested various other motivations why firms participate in

voluntary environmental programs. Many of these motivations are described below forming the basis for our analysis.

Motivation 1: Firms join the ENERGY STAR program in order to improve their image to consumers.

Videras and Alberini (2000) conclude that "public recognition is an important predictor of participation in a voluntary program, and firm management might feel under pressure to join for the reputation effect." The EPA works with the firms to set the energy standard and subsequently aids in marketing of the product through public education and information databases, thus subsidizing an attempt at image enhancement of the products and perhaps of the firms that market them (Howarth et al., 2000). In essence, the endorsement of the ENERGY STAR logo involves an attempt to promote the purchase of energy-efficient products - a positive action for the manufacturing firm and the retailer who sell the product.

Motivation 2 Firms join ENERGY STAR to improve their market share.

According to Paton (2000) the "Porter hypothesis" states "firms acting individually to improve their environmental performance may – under appropriate circumstances – simultaneously increase profits." Additionally, studies conducted by Porter and van der Linde and reported by Paton (2000) confirm that firms who improve their environmental performance often gain a competitive advantage.

Motivation 3: Firms join ENERGY STAR because of the quality and characteristics of other participants in the program.

Firms might join voluntary environmental programs because the leading companies in their product category, with respect to sales and reputation, have already joined the program. The acceptance of the program by these companies likely endorses

ENERGY STAR as an accepted standard against which similar products are compared subsequently. Furthermore, the EPA promotes outstanding partners by awarding the "ENERGY STAR Partner of the Year" providing high visibility to these firms. We hypothesize that this provides a strong incentive for other companies to follow the industry leaders in joining the program, a process referred to by Abrahamson (1991) as "observation of practice."

This specific process is defined as a firm, or its manager, simply observing leading firms that join the program. The firm, or its manager, then notes the positive benefits the leading firm received after joining the program such as increase of sales volume, enhanced visibility to consumers, increased market share, etc. In other words, specific corporate goals are accomplished, or are much likely to be accomplished, if the firm joins in. This is called "observation of the outcome" where adopters observe the potential consequences that the specific choice might have to their organization (Abrahamson, 1991).

Motivation 4: Firms join the ENERGY STAR program in order to improve their relationship with the EPA.

Joining voluntary environmental programs could lead to a better relationship with the EPA, resulting in more flexible enforcement and possible easement of regulatory pressure. We expect that firms generally strive for a good relationship with the EPA and therefore join voluntary programs such as ENERGY STAR.

Motivation 5: Firms join ENERGY STAR to aid in employee morale, recruitment and retention.

Participation in the ENERGY STAR Program can give employees a sense of pride that the company they work for is making substantial progress in improving

environmental quality. Providing this sense of pride can lead to increased performance on the part of the employee. Environmentally-conscious people may desire to work only for "green" companies, thus a participating firm has a larger market for employees as well. We hypothesize that firms join ENERGY STAR to reap these benefits.

Motivation 6: Firms join ENERGY STAR to improve product distribution.

In addition to creating partnerships with product manufacturers, the EPA increasingly fosters the involvement of major product retailers. For example in 2000, Sears, Roebuck and Company pledged to sell more than one million ENERGY STAR labeled appliances and exceeded this goal by promoting ENERGY STAR in over 1,500 stores nationwide (EPA, 2001). As of today, there are 865 retail partners endorsing ENERGY STAR products. This could considerably improve the distribution of a firm's products and therefore represents an important incentive for joining the program.

Motivation 7: Firms join ENERGY STAR to promote the design of additional energy-efficient products.

We believe that joining the ENERGY STAR program facilitates the design and development of more energy-efficient products within a firm due to the resources provided by the EPA and the importance placed on product energy efficiency in the wake of this partnership. This could provide a competitive advantage to firms who engage in the design of energy-efficient products, thus appealing to firms, leading them to join.

Motivation 8: Firms join ENERGY STAR to increase government contracts.

As a consequence of the Executive Orders 12845 (April 21, 1993) and 13123 (June 8, 1999) government agencies are required to exclusively procure ENERGY STAR

labeled products. Obviously, the participation in ENERGY STAR therefore secures this market segment for only the participating firms.

Motivation 9: *Firms join ENERGY STAR to shape energy-efficiency standards.*

Joining the program provides the opportunity to actively participate in shaping design guidelines for energy-efficient products. A firm can assist in creating and crafting design requirements for a complete product category by being a charter ENERGY STAR partner with the EPA at the inception of the program for a new product or when a product category standard is up for review. We infer that a technologically advanced firm can therefore obtain a market advantage over less advanced firms because the cost of adoption of the standard is higher for the less advanced firms.

Motivation 10: *Firms join the ENERGY STAR program to enhance their image to investors.*

Environmental performance is increasingly used as a way to evaluate and select investments. For instance, Innovest, an investment research firm based in New York, uses environmental performance measures to rate firms for the purpose of investing. ENERGY STAR, as a label endorsed and promoted by the EPA, offers an easily accessible and objective way to assess a firm's performance with respect to energy efficiency. We expect that firms with an awareness of the importance of investors' evaluations may therefore be inclined to join environmental programs in order to appeal to these investors.

4.2.1 Comparison of Benefits and Expectations

According to Dowd (2000) and Howarth et al. (2000), firms will only join a voluntary environmental program if they perceive that substantial benefits will follow. We wanted to know if the expected benefits were fulfilled according to the partners.

This could provide the EPA with useful means of knowing how to improve the program and to make it more compatible with the firms' needs.

4.3 Hypotheses on When Firms Join

In this section, we develop hypotheses on how the motivations along with other firm characteristics influence the timing of joining.

Hypothesis 1: The closer the location of the firm to the EPA headquarters, the earlier the joining date.

DeCanio and Watkins (1998) found that there was a relationship between EPA regions and joining the Green Lights program (a voluntary environmental program launched in 1991 which encouraged the use and manufacture of energy-efficient lighting fixtures). EPA regions 2 (North East U.S.) and 3 (Mid-Atlantic) were more likely to join Green Lights (DeCanio, Watkins, 1998). Based on the similarity between Green Lights and ENERGY STAR, and the fact that Green Lights was merged with ENERGY STAR in 1998, we believe there may be a regional influence on the timing of a firm's decision to join ENERGY STAR.

Hypothesis 2: Larger firms, as measured by number of employees and volume of sales, join ENERGY STAR earlier than smaller firms.

An empirical analysis conducted by Videras and Alberini (2000) determined "larger firms may be more likely to participate because they are more visible or are industry leaders." With respect to number of employees, Videras and Alberini (2000) concluded that the larger the number of employees, the more likely a firm was to join Green Lights. They also concluded that financial performance had no relation to participation.

DeCanio and Watkins (1998), however, found a strong association between number of employees on the probability to join the Green Lights program. Larger firms were also more likely to participate in the EPA's 33/50 program than smaller firms as concluded in a study conducted by Arora and Cason (1995) and reported by DeCanio and Watkins (1998).

Hypothesis 3: "Greener" firms join ENERGY STAR earlier.

Arora and Cason (1996) as referenced in Videras and Alberini (1998) hypothesize that "firms with poor environmental performance may be more likely to participate in a voluntary program in hopes of obtaining relief from the EPA." It is our hypothesis that environmentally conscious firms will join earlier than those who are not as environmentally conscious, because they already have invested in measures necessary to be an ENERGY STAR partner. As proxy for these measures, we employ the firm's application of Design for Environment (DfE) principles or Life Cycle Analysis (LCA) tools as well as the existence of an environmental department.

Hypothesis 4: A firm's motivation for joining ENERGY STAR influences the time of joining.

We evaluate whether an increase in market share, an increase in employee morale, the recruitment and retention, an improvement in image to consumers, the quality and characteristics of other participants in the program, an enhancement in image to investors, an improvement of product distribution, an improvement in relationship with the EPA, an increase in the number of energy-efficient products a firm produces, an increase of attainable government contracts, and a gain in the ability to shape industry efficiency standards motivate firms to join ENERGY STAR because of the potential benefits they obtain. Based on this we hypothesize that firms join ENERGY STAR earlier

to incur the above benefits sooner and therefore to a greater extent than firms that join later.

4.4 Additional Characteristics of ENERGY STAR Partners

Knowledge of general characteristics of partners can add insight about the inherent characteristics of potential partners. In order to obtain this insight we posed the following questions:

- Whether the responding firm is also a building partner;
- Whether or not energy-efficiency was part of the firms mission statement or vision;
- At what management level in the firm the idea of joining the ENERGY STAR program was initiated;
- At what management level the MOU was signed;
- If there were benefits that a firm believed it could not achieve on its own;
- Through what channel did the firm first hear about the ENERGY STAR Program.

The ideas on motivations, benefit comparison, hypotheses, and additional characteristics of firms were used to formulate the questionnaire. Surveying is an effective way to obtain the necessary information to perform statistical analysis and draw general conclusions, since this information was not available from either the EPA, DOE, or other sources.

5.0 The Survey

In order to investigate the joining pattern, information about the actual characteristics of joining firms, their motivation for joining, and the specific benefits they perceive from participating in the program was crucial to our research. One effective way to obtain this kind of information in order to perform statistical analysis and draw general conclusions is to construct and administer a questionnaire to a large enough number of companies. This section will elucidate the specific requirements for designing a successful and useful questionnaire, as described by survey literature. Secondly, the theoretical explanations will be complemented with the realization of the concepts in the case of the ENERGY STAR® study.

5.1 Questionnaire Construction

The construction of a questionnaire is a highly systematic process, which can be subdivided into distinct steps (Peterson, 2000). First, the information requirements that necessitate the questionnaire have to be reviewed and identified (1st stage). This step is followed by the development and prioritization of a list of potential research questions that will satisfy the specific research requirements (2nd stage). After a careful assessment of each potential research question (3rd stage), the specific types of questions to be used in the questionnaire have to be determined (4th stage). Here one has to differentiate between open and close-ended questions. In the fifth step, the actual wording of each question has to be decided before the structure of the overall questionnaire can be finalized (6th stage). This initial design process is to be followed by an intensive evaluation stage. The evaluation can either be conducted by an expert panel with experience and knowledge about questionnaire design and/or the actual topic examined, or as a pretest involving a random sample of test participants which are similar to the

proposed study participants. The results of the evaluation provide feedback for a new review of the information requirements, as outlined above as stage 1, and thus initiate a reiteration of the complete design cycle with the questions and the structure of the questionnaire being refined to accommodate the changes proposed by the evaluation.

5.2 The ENERGY STAR Questionnaire

5.2.1 Definition of the Target Group of the Questionnaire

In developing the actual survey questions, a decisive step was the definition of the target group addressed by the questionnaire, so as to ensure that the study participants were, on the one hand capable of understanding the questions, but also willing and able to answer them (Fink, 1995a). The target group of the ENERGY STAR survey was relatively specific. As information about the firm itself and the behavior with respect to the ENERGY STAR program was necessary to fulfill the research requirements, only employees directly involved in implementing or administering the ENERGY STAR program within a company would be qualified to answer the questionnaire. Consequently, the target group for the survey consisted of individuals with some insight into the firm's proceedings and policies in particular. The target participants for the survey were program managers or administrators for ENERGY STAR or other environmental/energy-related programs in their company. The choice of this target group resulted in two major implications for the design of the questions and the structure of the questionnaire:

(1) Due to the assumption that the participants of the survey were familiar with the ENERGY STAR program in their firm, it was possible to construct questions asking for knowledge-based facts rather than merely preference-induced personal

opinions. Additionally, the perceived common knowledge of the participants about the ENERGY STAR program allowed for the conception of relatively detailed questions, asking for very specific information without the necessity for giving them extensive information.

(2) In analyzing the results of the questionnaire, the homogeneity of the target group allowed for the aggregation of the results and the better comparability among companies from different product categories (Babbie, 2001).

The design and evaluation process must take into account the extent to which participants' understanding and the researcher's understanding of a potential research question will coincide (Peterson, 2000). We administered two test-runs of the questionnaire with ENERGY STAR Program managers from two major computer companies to mitigate this problem. In a further step, the questionnaire was presented to a panel of academic and industrial experts who also provided suggestions for the improvement of the survey with respect to the aforementioned aspects.

Assuming that the survey participants actually had the knowledge to answer the questions based on their professional background, the uncertainty that remained was the willingness of participants to answer the questions. There are two main reasons why a participant might not answer a question: the participant might regard the required information as too personal or too confidential; or participants might be unwilling to answer because they think it is too time-consuming. The confidentiality aspect was a very important issue in case of the ENERGY STAR survey, since it was aimed at retrieving very specific company-related data and information about decision processes in a firm. In order to obtain as much truthful data as possible, the following measures were taken:

- The cover letter clearly identified the objectives of the study as purely academic.
- The cover letter stated that the data would only be used in an aggregate form, making the identification of a single company and the respective answers nearly impossible.
- The questionnaire refrained from using direct questions pertaining to sensitive firm information, such as information about sales, profits, share of ENERGY STAR products in the overall product range or number of ENERGY STAR products sold to the government.

These measures were taken not only to ensure that the questions were answered, but also to make sure that they were answered candidly. A large number of wrong or biased answers could alter the result of the data analysis considerably and would affect the outcome of the study by influencing the resulting policy implications. Thus, the questionnaire represented a compromise between the data obtained to satisfy the requirements of the research questions and the information the respondents were willing to reveal.

The effort and the time needed to answer a question or to complete the entire questionnaire were other decisive variables. Obviously, the more effort or time needed to answer a question, the less likely participants are to do so. For example, a question that requires research on the part of the participant or other lengthy inquiries would probably not be answered at all or answered incorrectly or inadequately. To accommodate these aspects, the ENERGY STAR questionnaire did not ask for exact information, and used ranges to retrieve the data. Also, the overall questionnaire was designed to take no longer than 15 minutes to complete, without the need for any further inquiries or research.

All survey data was entered into a Microsoft Access database, either automatically through the online survey, or manually when a written, E-mailed, or faxed questionnaire was received. In order to perform statistical calculations, the data were transferred into a statistical analysis package.

Due to incomplete information and technical errors, in some cases, formatting of the data was necessary. For example, with respect to the joining date, some companies included the month and year of joining, while others only included the year. We decided to use a month/year format. For data missing the month of joining, the month of June was assigned as the date likely to be the closest value to the actual, unknown date. In addition, there were responses such as "charter member." In such situations, we designated the month and year that the product category was introduced by ENERGY STAR. Also, large companies that are members of multiple categories only listed the date of joining for their first product category; they did not differentiate between categories. In situations like these, we designated the month and year that the product category was introduced by ENERGY STAR.

5.2.2 Types of Questions

The survey literature differentiates between two main types of questions: open and close-ended questions. Close-ended questions limit the respondents' answers to the survey. The participants are allowed to choose from either (1) a pre-existing set of dichotomous answers, such as yes/no, true/false, (2) a multiple choice with an option for "other," or (3) a ranking scale response option, where the respondent chooses the level of response he or she deems most appropriate. The most common ranking scale question is the Likert scale question. This kind of question asks the respondents to look

at a statement and then rate this statement according to the degree to which they agree, utilizing the categories "strongly agree," "somewhat agree," "no opinion," "somewhat disagree," "strongly disagree," representing a five–point scale (Creative Research Systems, 2000).

In close-ended questions it is considered important to always provide the possibility of an "other," "don't know," or "not applicable" answer possibility. Although such an answer is mostly a loss to the researcher it helps to avoid frustration on the side of the participants and thus a possible discontinuation of the survey.

Open-ended questions do not provide the respondents with answers to choose from, but are rather phrased in a way that the respondents are encouraged to explain their answers and reactions to the questions with a sentence, a paragraph or even a page or more, depending on the survey. One can further differentiate open-ended questions into numeric and text-open ended questions, where numeric open-ended questions oftentimes refer to ratings or rankings the respondents are asked to give. Text or verbatim open-ended questions require an actual text as an answer (Peterson, 2000).

In the ENERGY STAR questionnaire, most of the questions with the exception of three - parts of question 1, which asked for basic information about the company, question 3, and the supplementary part of question 11 – were close-ended questions, offering a choice of answers ranging from yes/no answers to number ranges and pre-defined answer choices to the agreement rating techniques in questions 4 and 14.

5.2.3 Structure of the Questionnaire

The structure of the questionnaire was, to a great extent, determined by the information needs outlined above, the target group of survey participants described, the research hypotheses, and necessary background information. The questions were

ordered in a way that allowed for a logical structure throughout the entire questionnaire. The specific elements of the ENERGY STAR survey will be discussed in the following section. Refer to Appendix D for the questionnaire.

The first three questions can be considered the "warm up" questions, designed to be relatively easy to answer so to allow the participants a good start with the questionnaire.

Question 3 - *What month and year did your company become a participating ENERGY STAR product manufacturer?* - is a very decisive question. This information is crucial for the later analyses, as it serves as the dependent variable for our hypotheses. As the examination of joining is inherently biased by the target group sample, only companies that actually have joined were considered and thus committed to the program. Therefore, the dependent variable chosen is the date of joining as a measure of the patterns of participation in the program in a specific product category, rather than the joining decision itself. The investigation of the joining phenomenon itself would only be possible in comparison with a well-defined control group - i.e. companies in the same category and with similar characteristics that haven't yet joined the program.

Question 4 - *Why did your company join ENERGY STAR?* - consisted of a set of statements aimed at eliciting the inherent motivations for companies to join the program. The survey participants were asked to rank on a close-ended agreement scale the different motivations provided with respect to the relative, perceived importance for the respective company. The fact that the selection of the possible motivations for joining has to be limited and is based on the researchers' own perception of the situation might be construed as a bias. However, this argument is at least partly mitigated by the fact

that some of the motivations chosen and offered in the questionnaire were derived from the peer-reviewed literature on firms' incentives to join voluntary government environmental programs as outlined in Section 4.0 above.

The individual motives for joining presented in the survey appear in an order that starts out with an incentive that is likely to be agreed with by many participants (increased market share).

While Question 4 concentrated on the motivations of a company for joining, **Question 5** - *Which of the following benefits did you think the EPA could provide to your company, which were difficult or unable to be achieved on your own?* - focused on the specific role of the EPA in achieving the perceived benefits and the companies' expectations with respect to the support offered by the EPA.

Question 6 - *How did your company first hear about ENERGY STAR?* - was intended to lead to a better understanding of the industry-specific information pathways with respect to voluntary environmental programs. The information obtained through this question was expected to result in guidelines as how to introduce relevant information about government programs to a specific industry and how it is most likely to be accepted by the companies in this industry.

Whereas this reveals information about the industry-specific information flows, the following questions were included in the questionnaire to elicit information about the organizational circumstances, under which decisions about the participation in a voluntary program were made. **Question 7** - *At what level was the idea of joining ENERGY STAR initiated?* - looks at who within a firm's organizational structure recommended joining ENERGY STAR, whilst **Question 8** - *What management level signed the final ENERGY*

STAR agreement with the EPA/DOE? - reveals the importance attributed to environmental affairs within the company. This is also supported by **Question 9** - *Is enhancing energy performance of your products part of your company's written overall mission statement or vision?* - as it asks about the integration of the concept of energy efficiency in the company's overall set of values.

Questions 10 - *Does your company have a specific environmental affairs department/division?,* **11** - *Is your company part of any other EPA voluntary environmental quality programs?,* **12** - *Was your company using Design for the Environment (DfE) tools previous to entering ENERGY STAR?*, **13** - *Was your company using Life Cycle Analysis (LCA) tools previous to entering ENERGY STAR?* - serve as background environmental information about the firms and also used in analyzing *Hypothesis 3*. This allowed for making connections between energy efficiency and other environmental management processes.

Finally, **Question 14** - *Please rate each of the following BENEFITS of joining ENERGY STAR from 1 to 5, with 1 being STRONGLY DISAGREE and 5 being STRONGLY AGREE* - closed the circle with a strong reference to question 4. Questions 4 and 14 featured a very similar structure and offered nearly identical answer choices. They were spaced out and separated by other questions in order to discourage survey participants from simply copying their answers for question 4 to question 14.

The survey concluded with a name field that gave the respondents the opportunity to provide their contact information and offer feedback to the researchers while also asking if the participants wanted a copy of the completed report. This structure is the product of a long refining process. As many as 12 different versions of

the questionnaire were constructed, reviewed and altered to ensure the research objectives were properly met.

5.2.4 Mode of Administering the Survey

The choice of the method of survey administration always depends on several factors with partially conflicting requirements:

- the information requirements as outlined by the research questions;
- the characteristics of the survey's target group;
- the cost and time expenses arising with the administration of the survey;
- the number of participants addressed by the survey.

The mode of administration of the survey as well as the evaluation of the target group considerably influenced the design of the actual research questions in the questionnaire. In a survey administered via E-mail or mail, the questions need to be more easily understandable and therefore more clearly defined than in a telephone survey or a face-to-face interview. In the latter cases, the survey designer has the opportunity to account for and clarify difficult aspects and passages of the questionnaire by training the persons administering the survey respectively. Also, face-to-face and, to a limited extent, telephone surveys allow for monitoring the portion of a response that is not necessarily revealed by the pure answers to the questionnaire, such as problems in answering a question or making a decision in favor of one or the other answer. In addition, administering a survey utilizing interviewers might get a better response rate than E-mail or mail surveys, as people are possibly more willing to respond to a person asking questions than to a relatively impersonal E-mail or letter (Fink, 1995a). On the other hand, due to this personal interaction of interviewer and participant, face-to-face surveys and, to a certain extent, phone surveys are subject to a major potential bias, which is

referred to as the "interviewer bias" in survey literature (Peterson, 2000). According to this approach, participants are therefore more likely to give favorable answers because they tend to construe a connection between the interviewer and the questions asked. Thus, the E-mail/mail administration of the ENERGY STAR survey avoided this bias while risking a low response rate. This was more aggravated by the fact that a self-administered survey made it necessary that the completed questionnaire was returned to the researchers. This step was designed to be as convenient as possible for the ENERGY STAR survey by providing the possibility of answering the questionnaire directly in an on-line format and by enclosing stamped return envelopes for mailed surveys.

Another negative aspect of the mailed survey was the time needed to send out the questionnaire and to receive the answers and thus the results of the survey. In case of the ENERGY STAR survey, the preparation of the mailing took at least 40 man-hours for each of the three mailing waves. The recipients were given 3 to 4 weeks to respond to the survey. Consequently, the whole survey procedure took three months to complete, with answers received throughout this entire period.

E-mail and on-line surveys are clearly cheaper than mailed surveys through the U.S. Postal Service (USPS). However, problems arise when recipients consider unsolicited E-mail as junk mail. Also, some people are not familiar with handling E-mail attachments or are concerned with possible viruses, and delete the E-mail even though they may be willing to answer it.

The advantages of E-mail surveys, to a great extent, can also be applied to Internet-based questionnaires. Thus, we included a hyperlink to our on-line version of the questionnaire because the respective target group was assumed to have the necessary Internet access and knowledge to complete the questionnaire on-line. Unfortunately, Internet surveys still suffer from technical problems, such as server downtimes and

incompatibility between different versions of Internet software. Nevertheless, we wanted to provide our potential respondents with as many options as possible for answering the questionnaire. The following section will outline our response rate by survey administration mode and by product category.

5.2.5 Descriptive Statistics for Questionnaire Responses

Our data collection consisted of two methods: a non-random survey sent to ENERGY STAR partners in specific product categories and secondary data sources produced by the EPA (i.e. program joining dates for facsimile machines, photocopiers, scanners, multifunction devices, computers, and monitors, etc.).

Due to the number of partners and the information availability we researched and surveyed partners in 17 categories out of the current 33 ENERGY STAR categories. We further reduced our sample categories to 14 based on survey response and availability of contact information. The following table identifies the 14 ENERGY STAR categories, the date each product category was introduced and the total number of firms in each category.

Product Category	EPA Product Category Initiation Date (month/year)	Number of Firms
Computers	Jun/1992	71
Monitors	Jun/1992	75
Facsimile Machine, Printer, and Mailing Machines	Oct/1994	73
Photocopiers	Apr/1995	21
Thermostats	Apr/1995	9
Air Conditioners	Apr/1995	22
Furnaces	Apr/1995	18
Geothermal Heat Pumps	Apr/1995	10
Boilers	Jun/1996	18
Exit Signs	Jun/1996	32
Scanners	Mar/1997	16
Multifunction Devices	Mar/1997	18
Lighting Fixtures	Mar/1997	53
Roofing	Feb/1999	137
Total Number of Firms		**573**

Table 6: EPA Product Categories and Initiation Dates

A questionnaire was sent to a representative of each firm identified by the EPA as the firm's contact for ENERGY STAR program information. A total of 164 questionnaires were received from the 600 ENERGY STAR partners who were asked. The questionnaires were sent in three waves between October and December 2001 via electronic mail (if an E-mail address was provided) and USPS mail if there was no electronic mail address. The total number of overall questionnaires sent in the three waves was 1,735. Some of the questionnaires sent via electronic mail were immediately rejected due to incorrect E-mail addresses and we therefore sent a questionnaire via USPS mail. Additionally, some mailing addresses were incorrect and resulted in USPS rejections. Thus, the 1,735 includes duplicate questionnaires sent to firms. After accounting for these duplications and rejections, the total number of questionnaires sent in the three waves was approximately 1,500.

Table 7 shows how the questionnaires were returned and at what time. Respective percentages per mode and wave are given in parentheses. Additionally, the responses received per mode sent broken down by electronic media (E-mail and web on-line), hardcopy (USPS and facsimile) and phone is reported. This suggests that more answers were solicited by USPS mail than by any other means.

Mode of Survey Return	Number of Surveys Returned in Wave 1	Number of Surveys Returned in Wave 2	Number of Surveys Returned in Wave 3	Number of Surveys Returned Total	Response per Media (1,735 surveys sent)
Electronic Mail	14 (21.5%)	10 (23.8%)	4 (7.0%)	28 (17.1%)	8.0%
Web On-line	31 (47.7%)	19 (45.2%)	0 (0.0%)	50 (30.5%)	
USPS Mail	19 (29.2%)	11 (26.2%)	49 (86.0%)	79 (48.2%)	11.3%
Facsimile	1 (1.5%)	2 (4.8%)	3 (5.3%)	6 (3.7%)	
Phone	0 (0.0%)	0 (0.0%)	1 (1.8%)	1 (0.6%)	6.0%
Total Number of Surveys Returned	65 (100%)	42 (100%)	57 (100%)	164 (100%)	

Table 7: Modes of Questionnaire Returned in Each Wave

It should be noted that Wave 3 was sent exclusively via USPS mail and therefore, the web on-line option was not offered. In addition, as part of Wave 3, 30 firms in the Thermostats, Boilers, Furnaces, and Geothermal Heat Pumps product categories were telephoned to request the completed questionnaire. These categories were selected due to the already high response rates from the first three waves of questionnaires.

Table 8 shows the number of questionnaire responses and return rates per product category. After accounting for 25 duplications (some firms are partners in multiple product categories) and deleting 27 rejected questionnaires due to incorrect contact information, we achieved an overall response rate of 29.3 percent. The product categories have been ranked from highest response rate (boilers) to lowest (monitors).

Respondent Numbers from Fourteen Categories Used in Our Analysis

ENERGY STAR Product Category	Questionnaires	Rejected Questionnaires	Partner Totals	Return Rate	Ranking
Fax Machines, etc.	12	8	65	18.5%	11
Photocopiers	4	1	20	20.0%	10
Scanners	2	2	14	14.3%	12
Multifunction Devices	6	1	17	35.3%	7
Computers	8	5	66	12.1%	13
Monitors	8	4	71	11.3%	14
Thermostats	4	0	9	44.4%	3
Air Conditioners	5	1	21	23.8%	9
Boilers	12	0	18	66.7%	1
Furnaces	6	0	18	33.3%	8
Geothermal Heat Pumps	5	0	10	50.0%	2
Lighting Fixtures	22	0	53	41.5%	5
Exit Signs	13	1	31	41.9%	4
Roofing	53	4	133	39.8%	6
Total	**160**	**27**	**546**	**29.3%**	
Minus Multiple Category	25				
Number of Questionnaires Received	135				

Table 8: Number and Percentage of Surveys Received in Each Product Category

6.0 Analysis and Results

The primary objective of our research is to evaluate why and when firms participate in the EPA's voluntary environmental program ENERGY STAR®. To address this objective, we first analyzed the evaluation of each of the given joining incentives to identify the main reasons for joining the program as stated by the survey participants. This answers the *why* question. Secondly, a multiple regression analysis was performed to identify the variables, which significantly influence the time a company joins the ENERGY STAR program. This represents our approach to the *when* question, as defined in our hypotheses.

6.1. Why Firms Join ENERGY STAR

We hypothesized that the following motivations existed for a firm to join ENERGY STAR: improving the relationship with the EPA, improving the image with consumers, increasing market share, aiding in employee morale, recruitment, and retention, the quality/characteristics of other participants in the program, enhancing image to investors, improving product distribution, promoting the design of additional energy efficient products, increasing government contracts, and shaping industry energy efficiency standards.

In the questionnaire, the respondents were provided with five answer choices for rating each incentive for joining ENERGY STAR that we proposed. The pie charts in Figure 7 through Figure 15 condense the five possible answer choices in the questionnaire into three importance categories for illustration purposes. Specifically, choices one and two were grouped together as "least important" and choices four and five were grouped together as "most important."

In the following section we present the results of the analysis of the firms' motivations for joining ENERGY STAR.

Motivation 1: Firms join the ENERGY STAR program in order to improve their image to consumers.

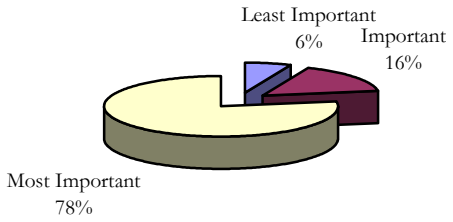


Figure 7: Percentages of Responses to *Improve Image to Consumers*

The goal of appealing to consumers by offering ENERGY STAR labeled products has been rated as "most important" by the majority of the survey participants.

Motivation 2: Firms join ENERGY STAR to improve market share.

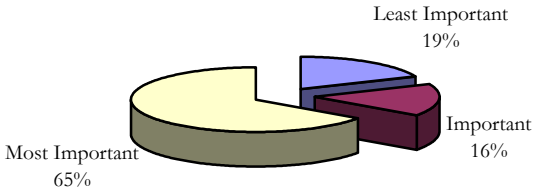


Figure 8: Percentages of Responses for *Improve Market Share*

An almost equally important reason for joining the ENERGY STAR program is the possible enlargement of a firm's market share through offering labeled products.

<u>Motivation 3</u>: Firms join ENERGY STAR because of the quality/characteristics of other participants in the program.

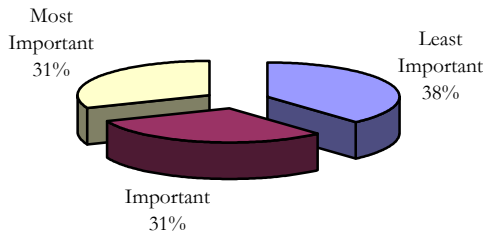


Figure 9: Percentages of Responses to *Because of the Quality/Characteristics of Other Participants in the Program*

With respect to the joining decision, the quality and characteristics of companies that have already joined the program received an evenly-distributed rating. The numbers of survey respondents that considered these factors as "most important," "important," and "least important" are very similar. However, it should be noted that 62 percent consider the quality and characteristics of firms in the program as an "important" or "most important" incentive for joining.

Motivation 4: *Firms join the ENERGY STAR program in order to improve their relationship with the EPA.*

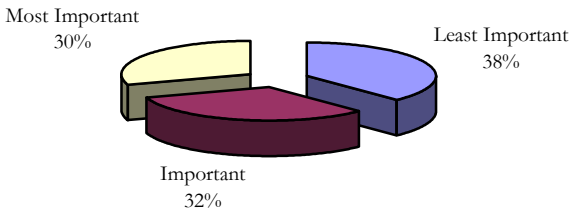


Figure 10: Percentages of Responses to *Improve Relationship With EPA*

The ratings for this incentive are almost evenly distributed among the "most important," "important," and "least important" categories. However, the survey response reveals that 62 percent of the respondents found that this incentive is "important" or "most important."

Motivation 5: *Firms join ENERGY STAR in order to aid in employee morale, recruitment and retention.*

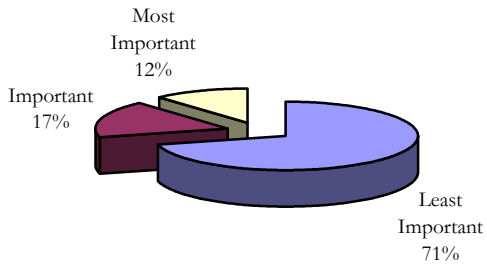


Figure 11: Percentages of Responses to *Aid in Employee Morale, Recruitment, and Retention*

Organizational aspects, specifically the motivation, recruitment and retention of employees, do not appear to play an important role when firms decide to join the ENERGY STAR program. The rating of this motivation indicates that the survey respondents' perceived importance of this incentive as comparably low.

Motivation 6: Firms join the ENERGY STAR Program to improve product distribution.

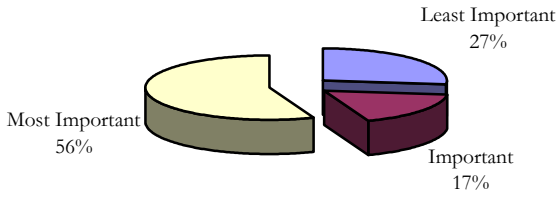


Figure 12: Percentages of Responses to *Improve Product Distribution*

ENERGY STAR is perceived as an important tool to increase product distribution, as 73 percent of the survey respondents consider this an "important" or "most important" incentive for joining.

Motivation 7: Firms join the ENERGY STAR program to promote the design of additional energy-efficient products.

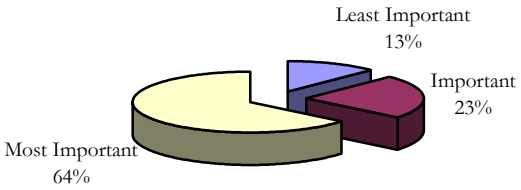


Figure 13: Percentages of Responses to *Promote the Design of Additional Energy Efficient Products*

The incentive of promoting the design of energy-efficient products was highly rated by a considerable number of survey respondents. This indicates that ENERGY STAR is considered as a very important tool in designing the energy efficiency attributes of a product.

Motivation 8: Firms join the ENERGY STAR program to increase government contracts.

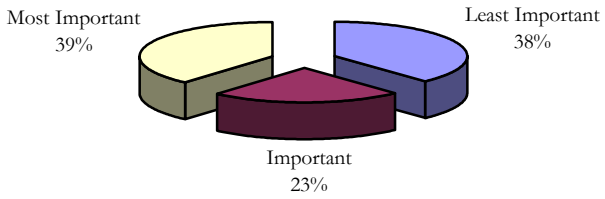


Figure 14: Percentages of Responses to *Increase Government Contracts*

The ratings for this incentive reveal that 62 percent of the respondents consider this an "important" or "most important" motivation for joining the program, whereas 38 percent believe that this incentive is "least important."

Motivation 9: Firms join the ENERGY STAR program to shape industry energy-efficiency standards.

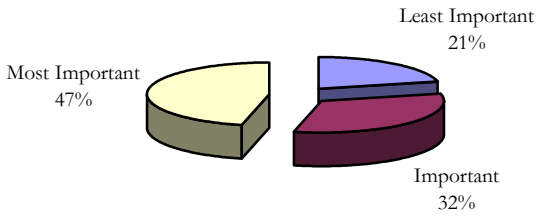


Figure 15: Percentages of Responses to *Shape Industry Energy-Efficiency Standards*

The possibility of participating in shaping the industry energy-efficiency standards is considered the "most important" incentive by almost 50 percent of the survey respondents.

Motivation 10: Firms join the ENERGY STAR program to enhance the image to investors.

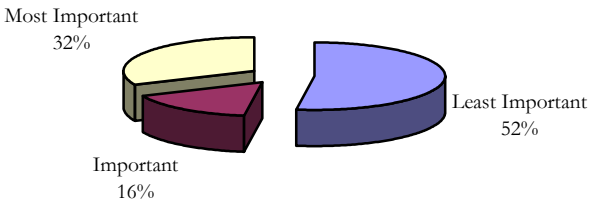


Figure 16: Percentages of Responses to *Enhance Image to Investors*

The possibility of improving a firm's image with investors receives a "least important" rating from 52 percent of survey participants, suggesting the relatively low importance of this incentive.

6.1.1 Comparative Ranking of the Results

Motivation	Rank Based on "Most Important" Responses	Percentage of "Most Important" Responses
Improve Image to Consumers	**1**	78
Improve Market Share	**2**	65
Promote the Design of Additional Energy-Efficient Products	**3**	64
Improve Product Distribution	**4**	56
Shape Industry Energy-efficiency Standards	**5**	47
Increase Government Contracts	**6**	39
Enhance Image to Investors	**7**	32
Quality and Characteristics of Other Participants	**8**	31
Improve Relationship with the EPA	**9**	30
Aid in Employee Morale	**10**	12

Table 9: Ranking of Incentives Based on "Most Important" Responses

A ranking of the results based on the "most important" percentages indicates that the motivation *improve image to consumers* is considered as "most important" by the majority of survey respondents. The incentive *increase market share* ranks second with respect to perceived importance. However, this incentive is almost equivalent to *design of energy-efficient products* in terms of the percentage of firms that deemed this motivation to be "most important." It should furthermore be noted that more than 50 percent of the survey respondents attributed a high importance to the motivation *improve product distribution*. *Employee morale, recruitment and retention* as well as *improving the image to investors* received the highest number of "least important" evaluations from the survey respondents. The bandwagon incentive, *joining because of the quality/characteristics of other participants in the program,* as well as the incentives pertaining to the *relationship with the EPA*, *government contracts*, and the possibility to *shape industry energy-efficiency standards* received a heterogeneous evaluation by the survey respondents.

6.1.2 Comparison of Benefits and Expectations

Another important finding of the study was the assessment of whether the participants of the program have yet received the benefits they expected from participation in the program. We compared the answers to question 4 (where the respondent was asked to rate the possible incentives) to the answers to question 14 (where the respondent was asked to rate the perceived benefits of joining). If the respondent rated a possible incentive with 4 or higher it meant that this particular incentive was one of the main reasons why the firm joined. Similarly, if a respondent rated a benefit high (4 or 5), it meant that the particular firm reported that it realized the

specific benefit due to joining ENERGY STAR. The answers to the corresponding questions are compared pair-wise. The results are presented in the following figure:

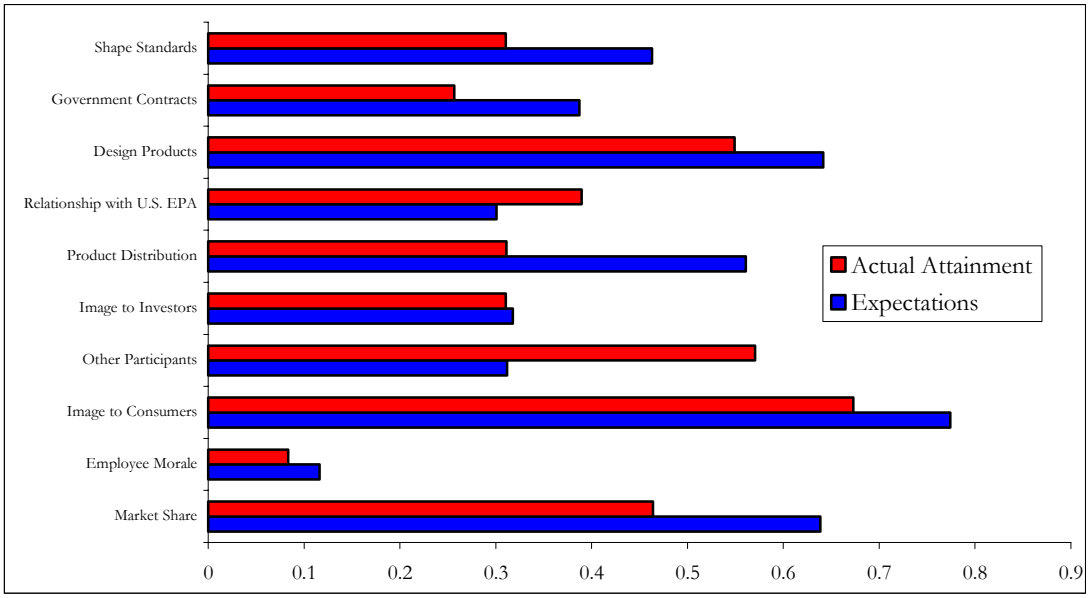


Figure 17: Comparison of Expected Benefits to Actual Benefits

The results demonstrate that many expected benefits were not realized after joining the program. For example about 64 percent of the 145 respondents said that the expectation of a *positive effect on market share* was an important incentive to join, but only 47 percent of respondents felt that the actual benefit of attaining a higher market share was realized after joining. Equally, there were far more firms that expected an *improvement in product distribution* from joining the ENERGY STAR program than those who actually received this benefit. The results also fell short of the expectation with respect to the motivations *shape industry energy-efficiency standards* and *improve image to consumers*. It is probable that some of the expected benefits were not yet attained at the time of the survey but may well be attained in the future.

On the other hand, the results also indicate that, although the *quality and characteristics of other firms* might not have been a strong motivation for joining, 60 percent of the respondents felt that after joining ENERGY STAR they were in a better position to compete within their industry.

6.2 Hypotheses on When Firms Join ENERGY STAR

6.2.1 Linear Regression

Performing a multiple regression allows for the inclusion of a variety of independent variables in a linear model and consequently for the consideration of the interaction between these different factors in predicting the dependent variable, which in our case represents the time at which a company joined the ENERGY STAR program after the introduction of the program in the relevant product category. The definition of the dependent variable is crucial to setting up the linear regression model.

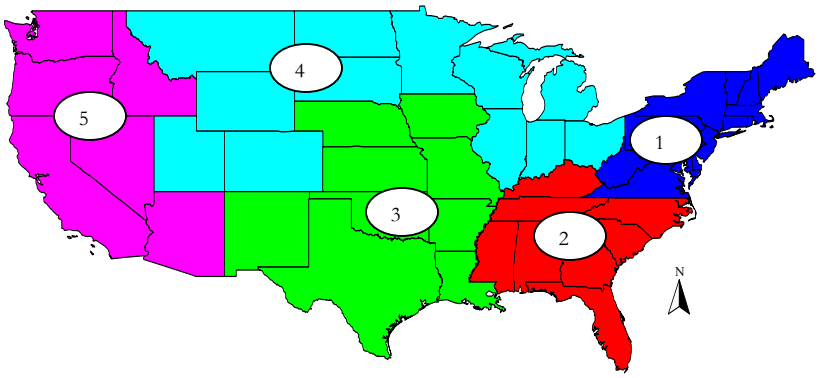
6.2.1.1 Description of the Dependent Variable

Due to the heterogeneity with respect to program initiation dates among the different product categories, it was not possible to use the date of joining, as provided by the survey respondents, as the dependent variable. In order to compare the joining pattern of the different product categories with each other and to include all survey responses in the regression, it was necessary to normalize the joining dates.

Two different methods were applied in deriving a normalized dependent variable (*time of joining*). For the first method, the dependent variable was calculated based on how many months after the initiation of the program for a specific product category a firm joined the program. In the second approach, firms were assigned ranks according to the order in which they joined in their respective product categories.

6.2.1.2 Description of the Independent Variables

In approaching the differences in joining dates due to location, companies are grouped into six categories. Five of these categories represented groupings of EPA regions within the continental United States. The breakdown of the categories is represented in Figure 18. The sixth category contains all international companies.



Region and Geographic Area	States
Region 1- North-East	ME, VT, NH, MA, RI, CT, NY, NJ, PR, PA, WV, VA, DE, MD, DC
Region 2- South-East	KY, NC, SC, TN, MS, AL, GA, FL
Region 3- South-Central	LA, TX, AR, OK, NM, KS, MO, NE, IA
Region 4- North Central	MT, ND, SD, WY, UT, CO, MN, WI, MI, IL, IN, OH
Region 5- West	WA, OR, ID, CA, NV, AZ

Figure 18: US Regions for the Location Analysis

In order to control for differences with respect to the joining date between product categories, these are grouped into five metasectors, based on similar Standard Industrial Classification (SIC) codes.

Product Category	Metasector
Facsimile Machines, etc.	1
Photocopiers	1
Scanners	1
Multifunction Devices	1
Computers	1
Monitors	1
Thermostats	2
Air Conditioners	2
Boilers	3
Furnaces	3
Lighting Fixtures	4
Exit Signs	4
Roofing	5

Table 10: Aggregation of ENERGY STAR Categories into Metasectors by SIC Codes

As a proxy for the firm size either number of employees or volume of sales could be used, as these are usually highly correlated. However, our correlation analysis indicated that, due to the categorized nature of the volume of sales response, the correlation between these two variables was only moderate (correlation coefficient: 0.3), therefore both were included in the model. While number of employees entered the model directly, the volume of sales information was modified in order to transform the provided categorical answers into a reasonable continuous format. To this end the geometric mean of each volume of sales category was calculated and transformed using the decimal logarithm.

Category of Volume of Sales ($)	Geometric Mean of Volume of Sales	Decimal Logarithm of the Geometric Mean of Volume of Sales
0 - 5million	2236.1	3.35
5 million – 50 million	15811388.3	7.20
50 million - 500 million	158113883	8.20
500 million - 5billion	1581138830	9.20
5 billion or more	15811388301	10.20

Table 11: Derivation of the Logarithm of the Geometric Mean for the Volume of Sales

Other survey answers that were included in the linear model were the existence of an environmental department, the application of DfE principles and LCA tools and the participation in other voluntary environmental programs. These variables are

introduced as a proxy for the "greenness" of a firm. Finally, the rankings provided for the incentives provided by survey question four were also included in the model.

6.2.1.3 Model Set-up

Due to the categorical nature of many of the variables described above, it was necessary to express almost all of the effects as dummy variables. The variables used in the models are denoted in *italics as* follows. The six location categories were represented by five dummy variables (*north-east, south-east, north-central, south-central, west*); equally the five sectors were described by four dummy variables (*sector.dummy.1-4*). The information with respect to DfE (*dfe*), LCA (*lca*), other voluntary environmental programs (*other vep*) and environmental departments (*dep*) were already available in a binary format. The continuous variables in the model are number of employees (*employees*) and volume of sales after the conversion discussed above (*sales*). The incentive rankings enter the model as follows: positive effect on market share (*market*), employee morale and recruitment (*empmor*), image to consumers (*imagcon*), quality/characteristics of other participants (*qualpart*), image to investors (*imaginv*), improve product distribution (*proddist*), relationship with EPA (*relepa*), design of additional energy-efficient products (*addprod*), government contracts (*govcon*) and shape industry energy-efficiency standards (*indstand*). Appendix E provides information about the abundance of data points for each of our variables.

The model for the regression is represented by the following equation:

$$\begin{aligned} \textit{Time of Joining}_{f} = \text{Intercept}_{f} &+ L_1\,(\textit{north-east})_f + L_2\,(\textit{south-east})_f + L_3\,(\textit{south-central})_f + \\ &L_4\,(\textit{north-central})_f + L_5\,(\textit{west})_f + E\,(\textit{employees})_f + V\,(\textit{sales})_f + \\ &S_1\,(\textit{sector.dummy.1})_f + S_2\,(\textit{sector.dummy.2})_f + S_3\,(\textit{sector.dummy.3})_f + \\ &S_4\,(\textit{sector.dummy.4})_f + F_1\,(\textit{market})_f + F_2\,(\textit{empmor})_f + F_3\,(\textit{imagcon})_f + \\ &F_4\,(\textit{qualpart})_f + F_5\,(\textit{imaginv})_f + F_6\,(\textit{proddist})_f + F_7\,(\textit{relepa})_f + F_8\,(\textit{addprod}) + \\ &F_9\,(\textit{govcon})_f + F_{10}\,(\textit{indstand})_f + \text{VEP}\,(\textit{other vep})_f + \text{LC}\,(\textit{lca})_f + D\,(\textit{dfe})_f + \\ &P\,(\textit{dep})_f + \text{Error}_f \end{aligned}$$

The subscript *f* represents the data point for each firm. The regression coefficients for the 5 regions in the U.S. are represented as: L_1 (north-east), L_2 (south-east), L_3 (south-central), L_4 (north- central), L_5 (west). The regression coefficient for the metasector dummy variables are: S_1 (Sector 1), S_2 (Sector 2), S_3 (Sector 3), and S_4 (Sector 4). The regression coefficients for the motivations variables are: F_1 (market share), F_2 (employee morale, recruitment and retention), F_3 (image to consumers), F_4 (quality and characteristics of other participants), F_5 (image to investors), F_6 (product distribution), F_7 (relationship with the EPA), F_8 (design of additional energy-efficient products), F_9 (increasing government contracts), and F_{10} (shape industry energy-efficiency standards). Other regression coefficients include VEP (participation in other voluntary environmental programs), LC (utilization of life cycle analysis), D (utilization of Design for Environment), P (presence of an environmental department), E (number of employees), and V (volume of sales). The intercept represents the time of joining (dependent variable) if all the other variables in the model above were zero. The error term represents the residual of the (f)'s data point (i.e., the variability not explained by the model).

The available data points were entered into a statistical analysis package and a stepwise regression was performed in order to identify and estimate the significant parameters for the two different dependent variable options. For our following assessments we consider these parameters delivered by the stepwise regression as statistically significant. This concurs with applying a significance level of 0.1.

The linear regression based on the number of months the firm joined after the program was initiated for the respective product category identified the following statistically significant parameters.

Variable	Parameter	P-value
Intercept	27.081	0.0108
North.east	-22.643	0.0013
South.east	-34.123	0.0001
South.central	-17.949	0.04444
North.central	-25.246	0.0025
West	-13.353	0.0820
Employees	-0.0001	0.0656
Sector.dummy.1	18.558	0.0011
Sector.dummy.2	30.061	0.0002
Sector.dummy.3	19.463	0.0017
Empmor	-2.831	0.0559
Qualpart	-3.632	0.0521
Proddist	6.043	0.0004
Govcon	3.553	0.0090
Dfe	15.658	0.0117
Sales	-1.645	0.0754

Table 12: Parameters Significantly Affecting Time of Joining (Dependent Variable Based on Joining Date)

The regression based on the joining rank of each company in its respective product category is shown in Table 13.

Variable	Parameter	P-value
Intercept	19.2920	0.0009
South.central	8.0910	0.0387
Sector.dummy.1	-13.7692	0.0000
Sector.dummy.2	-14.0627	0.0029
Sector.dummy.3	-17.2303	0.0000
Sector.dummy.4	-12.1620	0.0000
Qualpart	-2.3675	0.0248
Proddist	2.7535	0.0056
Addprod	1.5195	0.1147
Other vep	6.3335	0.1068
Lca	-4.6480	0.0734
Sales	-1.1962	0.0249

Table 13: Parameters Significantly Affecting Time of Joining (Dependent Variable Normalized Based on Ranking Within Sector)

The comparison of the tables shown above reveals differences in the selection of parameters in the two models based on different dependent variables. Whereas the regression based on the normalization by joining date delivers all location dummies and only three sector dummies as significant, the regression based on ranking selects one location dummy as significant as well as all sector dummies. Both regressions identify the incentive quality and characteristics of the firms that have already joined (*qualpart*) and the improvement of product distribution (*proddist)* as significant. Other incentives that were significant in the first model are the employee morale (*empmor)* and government contracts (*govcon)*. The second regression identifies design of energy-efficient products (*addprod*) as significant. With respect to firm size, both regressions conclude that the volume of sales variable is statistically significant, whereas the number of employees was statistically significant only in the first regression. Also, the regressions select different determinants of the greenness of a firm. While the first regression chooses the DfE variable, the second delivers other voluntary environmental program and the LCA variables.

Although both regressions feature very similar R-squared values of 0.54 and 0.55 respectively, we decided to choose the regression based on the normalization by joining date for the following analyses. Due to the sparse data returned by our survey, this normalization method creates a more realistic picture of the actual joining pattern for each product category than the ranking method. If for example, only very few participants responded in a specific product category, a firm could receive a low rank (close to one), even if the firm joined late after the initiation of the program.

6.2.2 Hypotheses Analysis

Based on these findings, we are now positioned to review the hypotheses pertaining to the timing aspect of joining the program. Furthermore, in interpreting the results from the regression, complementary statistic analyses were conducted in some cases.

Hypothesis 1: *The closer the location of the firm to the EPA headquarters, the earlier the joining date.*

The parameters resulting from the regression based on the normalized joining dates show that all defined regions differ with respect to the average joining dates of companies. All *state.dummy* variables were identified as being significant. More specifically, the fact of all parameters being negative indicates that all domestic regions join earlier than the international firms. The parameters even allow a ranking with respect to joining time among the regions. According to our results, firms in region II (south-eastern states) tend to join earlier, followed by firms in region I (north-eastern states), IV, III (mid-western states) and V (western states). These findings suggest a gradient with respect to joining time throughout the U.S. with the companies closer to

the administrative center in Washington D.C. joining earlier on average than firms in states with their headquarter located at a further distance from EPA/DOE headquarters.

In order to support and verify the results generated by the multiple regression analysis, an analysis of variance (ANOVA) was performed based on the survey data. The ANOVA delivers an F-value of 6.46. This exceeds the critical F for 126 degrees of freedom by far and allows for the rejection of the null hypothesis (there are no differences among the region) with a high level of significance (p-value $2.33*10^{-5}$). This indicates that, in concordance with the results of the regression, a relationship between location of headquarters and date of joining exists. Using the mean joining dates in each region to construct a ranking among the regions leads to the same order of regions as suggested by the regression analysis.

Hypothesis 2: *Larger firms, as measured by number of employees and volume of sales, join ENERGY STAR earlier than smaller firms.*

Proxy: Number of Employees

The stepwise regression based on the normalized dates identified the number of employees as a significant variable (p-value: 0.06). However, the resulting parameter for the variable (*employees*) is relatively small and therefore the number of employees has to be considered as a low impact variable. Only an increase of the number of employees by 10,000 would result in a firm joining one month earlier. Still it should be noted that the result of the regression hints at the validity of Hypothesis 2. The negative sign of the parameter indicates that bigger companies join the program earlier than smaller companies.

In order to further understand the relationship between the number of employees and when the firm joined the program, another analysis was performed which accounts for the structural differences among the firms in different product categories. In classifying the companies we defined small, medium, and large firms based on the definitions provided by the Small Business Service and Department of Trade and Industry, both United Kingdom government agencies. Both agencies defined *small/micro* firms as those with 1 to 49 employees, *medium* firms as those with 50 to 249 employees and *large* firms as those with 250 and greater employees.

The total number of responses we analyzed was 160, but only 114 respondents replied with both number of employees and date of joining ENERGY STAR. The missing data points are listed above Table 14 along with the total number of responses. Appendix F contains a breakdown by product category of firms' joining patterns based on employee number.

Total Number of Responses = 160, Missing Data = 46

	% 1st Year of Program (YOP)	% 2nd YOP	% 3rd YOP	% 4th YOP	% 5th YOP	% 6th YOP	%7th YOP	% 8th YOP	% 9th YOP	% 10th YOP	Firm Totals [100%]
Small	41.0	12.8	30.8	5.1	5.1	0	2.6	0	2.6	0	39
Medium	37.5	16.7	4.2	12.5	4.2	4.2	8.3	12.5	0	0	24
Large	49.0	23.5	3.9	9.8	2.0	7.8	3.9	0	0	0	51

Table 14: Percent of Small/Medium/Large Firms and Their Joining Pattern

The analysis of the table given above shows a moderate trend in the joining behavior of small, medium, and large firms. 41 percent of the small firms, 37.5 percent of medium-sized firms, and 49 percent of large firms join in the first year of the program. A chi-squared test performed on the number of small, medium and large firms

that either joined during the first year of the program or during the remaining years (2^{nd}–10^{th} year grouped together) found that there was no significant difference between small, medium and large firms with respect to their joining period (X^2: 0.9, α-level: 0.05, d.f.: 2). This concurs with the previous assessment of number of employees as a weak predictor for the date of joining.

Proxy: Volume of Sales

Larger firms with a high volume of annual sales may have more resources to invest in programs such as ENERGY STAR than smaller firms with less annual sales. With respect to the variable volume of sales, entering the model as the logarithm of the geometric mean of the volume of sales categories provided in the questionnaire, the regression delivers a result in agreement with the impact of the number of employees. The parameter can be classified as significant (p-value: 0.075) and has a negative sign. With an increase of the logarithm of the volume of sales by one, a firm would have joined the program 1.6 months earlier. This allows for the conclusion that the bigger the volume of sales of a company the earlier they joined the ENERGY STAR program. To complement these findings and account for eventual inaccuracies in the regression due to the usage of the geometric mean, an analysis of the raw data using the actual volume of sales categories as provided by the survey was conducted.

The values in Table 15 represent the percent of firms in each sales category (Less than $5 Million; Between $5 Million and $50 Million; Between $50 Million and $500 Million; Between $500 Million and $5 Billion, and Greater Than $5 Billion) that joined the program in the representative year of the program (YOP) category. Percentages

were determined for each sector individually and totaled in the table below. Appendix G contains a breakdown by product category of firms joining in each year of the program.

	% 1st Year of Program	% 2nd YOP	% 3rd YOP	% 4th YOP	% 5th YOP	% 6th YOP	%7th YOP	% 8th YOP	% 9th YOP	% 10th YOP	Firm Totals [100%]
VS <$5 million	32	13.5	45.5	0	0	4.5	0	0	4.5	0	22
VS $5 - $50 million	45	17.5	10	10	2.5	0	7.5	7.5	0	0	40
VS $50 - $500 million	44	24	4	16	4	4	4	0	0	0	25
VS $500 million- $5 billion	47.8	21.7	17.4	8.6	4.3	0	0	0	0	0	23
> $5 billion	53.3	26.7	0	0	0	13.3	6.7	0	0	0	15

Table 15: Percent of Firms in Each Volume of Sales Category and Their Joining Pattern

Overall, it does appear that as the volume of sales increases, firms join earlier in the program. The table quantitatively shows that the majority of the firms (53.3%) with volume of sales greater than $5 billion joined in the first year of the program, as opposed to only 32 percent of firms with a volume of sales less than $5 million.

Hypothesis 3 *"Greener" firms join ENERGY STAR earlier.*

Many firms have a department devoted to environmental issues, which would imply that such firms are better suited to handle environmental issues and have the resources and skilled manpower to achieve a better environmental performance. Other indicators for the "greenness" of a firm are the participation in other voluntary environmental programs as well as the application of DfE principles in product design processes and the utilization of LCA in overall company management. All these variables were included in the linear regression. However, only the application of DfE principles was identified to be significant (p-value: 0.011) in affecting the date of joining.

Moreover, in contrast to our expectations, the application and thus the awareness of these principles do not lead to an earlier ENERGY STAR joining date. On the contrary, the result of the regression indicates that the firms that apply DfE join substantially later (about 15 months) than firms unaware of DfE.

To further investigate the effect of an environmental department, the percentages of firms with and without an environmental department that joined the program in each year of the program were calculated. The percentages for all sectors are shown in Table 16 below.

	% 1st Year of Program	% 2nd YOP	% 3rd YOP	% 4th YOP	% 5th YOP	% 6th YOP	%7th YOP	% 8th YOP	% 9th YOP	% 10th YOP	Firm Totals [100%]
Yes	39.5	29	10.5	2.6	5.3	2.6	2.6	5.3	2.6	0	38
No	39.5	17.4	19.7	10.5	2.3	4.7	4.7	1.2	0	0	86

Table 16: Total Number of Firms and Joining Date (Percentages)

The total number of responses we analyzed was 124. Based on Table 16 above, it appears that there is no distinction between firms that do have an environmental department and those that do not, in terms of joining earlier in the program. This finding is also supported by the t-test analysis (t-value: 0.46, t-crit: 1.6, p-value: 0.9). Appendix H contains a breakdown by product category of firms joining in each year of the program. In concluding, it can be said that the existence of an environmental department does not serve as a good predictor for the timing of joining of a firm.

In order to assess the effect of the application and awareness of LCA tools in a company on the joining date, a t-test was performed. The results indicate that there is no difference with respect to joining time between the companies that used LCA tools

and those that did not (t-value: 0.13, t-crit: 1.6, p-value 0.4). Consequently, this variable also cannot be considered as a good predictor for the joining pattern in industries.

As the final assumed feature of a "green" company we evaluated the effect of the participation in other voluntary programs on the joining time. The t-test for this factor delivered a significant difference with respect to the dependent variable between firms that participate in other voluntary environmental programs and those that do not. A comparison of the mean joining dates of these fractions reveals that in fact companies that do participate in other programs on average joined ENERGY STAR later. This result is also supported by the regression based on the rankings. The negative effect of the participation in other programs on the ENERGY STAR joining dates might be explained by the complacency of the respective companies. Having already joined other programs they might not perceive the necessity of joining ENERGY STAR. Also they might not expect an added value from the additional participation in ENERGY STAR.

In concluding, it can be stated that overall the features chosen in this study to define the "greenness" of a company do not serve as particularly good predictors of the time firms join the ENERGY STAR program. We came to this conclusion because three out of the four predictors are not significant. Therefore Hypothesis 3 has to be rejected.

Hypothesis 4: A firm's motivation for joining ENERGY STAR influences the time of joining.

As outlined in section 4.2 above, the perceived importance of the motivations for joining the ENERGY STAR program could serve as a proxy for the timing of the joining decision. The stepwise regression identifies the following incentives as significantly predicting the dependent variable:

- *Aid in employee moral, recruitment and retention* (value: -2.83, p-value: 0.055)

The significance and sign of this incentive imply that the higher companies rated this incentive, the earlier they joined the ENERGY STAR program. This proves Hypothesis 4 with respect to using the participation in the ENERGY STAR program as a tool for motivation, retaining, and recruiting current and future employees.

- *Because of the quality/characteristics of other participants in the program* (value: -3.632, p-value: 0.051)

Similarly, the regression results suggest that companies which placed significance on the quality of firms that have already joined the program became early joiners. This can be understood as a hint at an underlying bandwagon pattern with respect to the timing of joining the ENERGY STAR program.

- *Improve product distribution* (value: 6.043, p-value: 0.0004)

The parameter for the product distribution incentive reveals a negative effect on the time firms joined the program, implying a later joining date. A reason for this could be that major retailers were not added to the ENERGY STAR program until well after the beginning of the program. With the value of the parameter suggesting the importance of this factor, the launch of retailers might have prompted some companies to join later in the program.

- *Increase government contracts* (value: 3.55, p-value: 0.009)

Finally, attributing a high importance of increasing government contracts leads to a later joining date as suggested by the regression analysis. This result suggests that firms who rely on government contracts are usually more likely to show a predominantly

compliant behavior. The firms of this type are probably more used to passively waiting for the government to approach them with requirements and regulation rather than actively striving for pre-empting these regulations.

The other incentive ratings were not identified as significant variables by the stepwise regression, we therefore conclude that they are not relevant to firms with respect to the timing of the decision of joining ENERGY STAR.

6.3 Characteristics of ENERGY STAR Partners

A basic awareness of firms' characteristics is necessary for a full understanding of how motivations affect firms' behavior. In this section we address the information obtained through our survey.

Building Partners

The ENERGY STAR program has numerous program areas including manufacturing, buildings, homes, and natural gas. Our questionnaire only surveyed the manufacturing partners. Out of the total 152 firms who responded, 64 percent also participate in the building program. We imply that joining will spur involvement in other areas of the program due to the majority of firms being in both areas of the program.

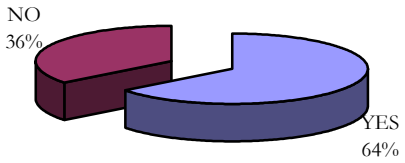


Figure 19: Percentages of Partners that also Participate in the Building Program

Energy-Efficiency as Part of a Firm's Overall Mission Statement

In addition, partners who had already committed to enhancing energy performance through their company's mission statement or vision may be more likely to join the ENERGY STAR program because they presumably had already achieved the standards. Therefore, joining would provide benefits without expenses for implementing new technology. However, out of the firms sampled, the majority do not have enhancing energy performance as part of their company's mission or vision.

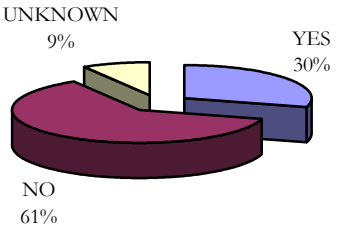


Figure 20: Enhancing Energy-Efficiency is Part of the Mission or Vision

Organizational Aspects: Level of Initiation of the ENERGY STAR Program and Signing the Final ENERGY STAR Agreement with the U.S. EPA

Does the placement of environmental affairs in the organization represent "greenness"? To determine this we asked where the joining of ENERGY STAR was initiated within the organizational structure of the partner firms. Shareholders did not initiate joining in any of the firms. CEO/President/Chairman was the most frequent response with a percentage of 42. Other highly rated responses were Department Head, and Product Design/Engineering Department. The Environmental Department, Board of Directors and Employees played only minor roles in initiating the joining of ENERGY

STAR. Additional comments provided on the survey show that the marketing department also played a major role in the decision to initiate the program. This department was not included in the choices provided in the survey.

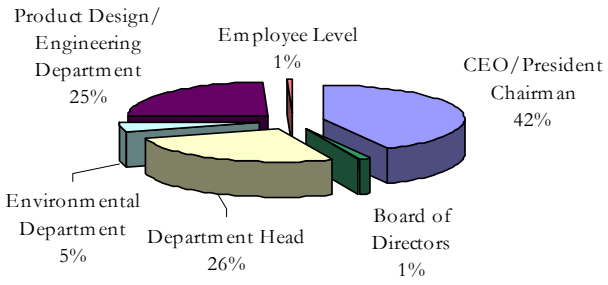


Figure 21: Organizational Level the Joining was Initiated

Benefits the Firms Expected to Receive from EPA

Any firm can increase the energy-efficiency of their products on its own. However, once a firm joins ENERGY STAR, the EPA becomes a major resource that can aid in providing benefits that cannot be achieved by the firm acting alone. The survey asked if any of the listed incentives fell into this category. No firms answered that the EPA was necessary to *aid in increasing employee morale, recruitment and retention* and in the *design of energy efficient products*. The highest percentage (28%) of survey respondents expected the EPA to be supportive in *shaping industry energy-efficiency standards*. This is easily explained, as the EPA is the governmental entity responsible for setting environmental standards. The partners rate *image to consumers* and an *improved relationship with the EPA* as very important benefits. Moreover the results imply that firms did not

expect any support from the EPA with respect to improving the energy-efficiency of their products. Also the survey respondents didn't believe that the EPA could be helpful in *improving product distribution*, *increasing the volume of sales* or *obtaining government contracts* without the aid of the EPA.

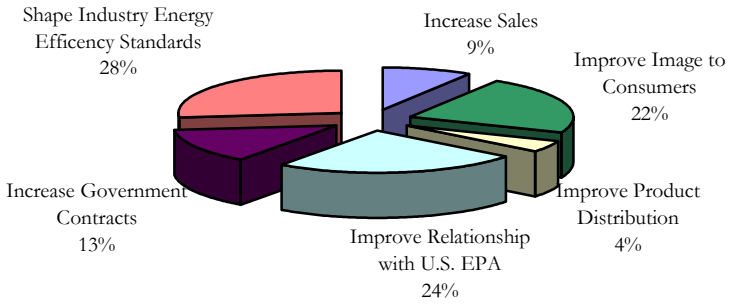


Figure 22: Benefits Firms Expected from the U.S. EPA

Success of ENERGY STAR Marketing Channels

In order for the EPA to expand the ENERGY STAR program, the most effective way of reaching potential members needs to be identified. The pie chart below shows that there is no dominant communication channel. The EPA directly approached most participants. Additionally, professional literature and trade associations were effective means for targeting partners. Nineteen percent chose the "other" option in the questionnaire. As this percentage was substantial, we looked at the completed questionnaires to see what the partners filled in for "other" option. The most common response dealt with recommendations from within their distribution chain, i.e.,

distributors, sales companies, and customers. Another common response was knowledge through Committee on Office Products Energy Efficiency (COPEE).

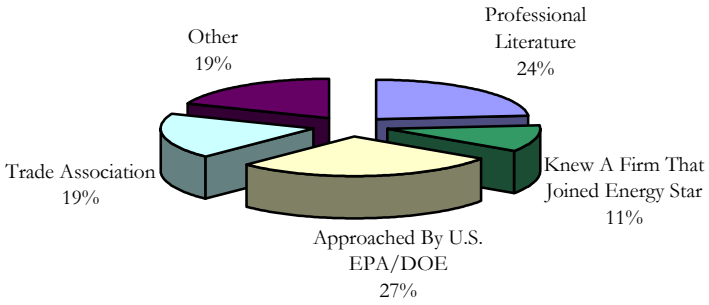


Figure 23: How Did Your Company First Hear About ENERGY STAR?

7.0 Conclusions

In 2000, the ENERGY STAR program achieved reductions of 35 million metric tons of carbon equivalent (MMTCE) (EPA, 2001). We wanted to determine why firms participate in the program and what private benefits they hoped to achieve by joining. Therefore, we studied the program participants to provide insight into the most important factors that motivate firms to take part in ENERGY STAR and what differentiates firms that join the program early from firms that join later.

Our main tool for collecting data on ENERGY STAR partners in this study was a questionnaire that was sent to a representative of each firm identified by the EPA as the firm's contact for the ENERGY STAR program. A total of 160 questionnaires were received from 573 ENERGY STAR partners, resulting in a response rate of 29 percent.

Summary of Results

Our results show that the majority of respondents considered the improvement of their *image to consumers* as the most important motivation for joining the ENERGY STAR program. The second most important motivation for joining the program was to *increase their market share*. This motivation was perceived almost as important as promoting the *design of additional energy-efficient products* within the firm. Furthermore, more than 50 percent of the survey respondents perceived the *improvement of product distribution* as an equally strong motivation.

Regarding factors that affect the speed of diffusion, a firm that highly valued the *quality and characteristics of firms* already in the program was more likely to join earlier. Another reason that influenced firms joining early was the *increase of employee satisfaction*. In contrast, if a firm sought to *increase the amount of government contracts* it could obtain, the

firm was more likely to join later. We believe firms joined later because the ENERGY STAR program received a significant boost late in the program (June 1999) with Executive Order 13123 requiring government agencies purchase ENERGY STAR compliant products exclusively. Additionally, we found that the ability of the program to *improve a firm's product distribution* was a motivation that prompted firms to join later. This may be explained because it was not until recently that the EPA instituted a campaign with retailers to improve product distribution of ENERGY STAR compliant products.

Recommendations

Our findings provide statistical evidence on the appropriate motivations for joining based on firm characteristics. The given incentives can provide insight into the motivations of firms for joining and thus could guide the EPA with respect to the areas of the program that require the most attention.

Since we found that the most important motivation to join was the *improvement of the firms' image to consumers*, we suggest the EPA should put the emphasis on educating consumers. For example, the EPA could highlight the cost reductions from using energy-saving products (which can be seen in consumers' monthly electricity bills). As consumers are educated on the cost reductions linked to ENERGY STAR, they might be more inclined to purchase these products.

An accessible database that includes compliance records and allows consumers to track firm records as well as purchase products from companies that are fully compliant or companies that have exceeded the standards, would be beneficial to the firm and the consumer. The EPA should consider gathering more information on the effect making this information public would have on the success of the program.

Since the *quality and the characteristics of the firms that have already joined* the program was another factor that positively affected diffusion, we suggest the EPA should first target the leading firms in each product category. Non-leading firms striving to obtain the same status of the leaders might result in more joiners and more innovative energy-efficient products. We propose that the EPA continue to publicize its top partners.

Our results indicate that some firms joined the ENERGY STAR program only after it emphasized cooperation with major retailers. Therefore, including retailers as a part of the program was confirmed to be an effective policy to gain more joiners after the initiation of the program.

Additionally, on the partner end, the EPA should consider keeping closer relations and soliciting feedback from its ENERGY STAR partners to ensure that their needs and expectations are met. Our research indicates that many firms have not yet received the benefits they considered important when they joined, such as an *increase in market share*, the *improvement of their image to consumers* as well as the *enhancement of product distribution*. Therefore, future research could be conducted pertaining to the actions the EPA could take to increase firms' satisfaction with the program.

Applicability of Our Results to Other Voluntary Environmental Programs

As other voluntary environmental programs may face the same challenge with respect to the participation of firms, the findings on the ENERGY STAR program can be used to update and develop other voluntary environmental programs. For example, DOE's Climate Challenge and EPA's Climate Wise are based on the disclosure of the firm's environmental achievements. Consequently, the findings of our study, which imply that firms want to improve their environmental image to consumers could provide

a rationale for the EPA to design an advertisement campaign to better proclaim such achievements and promote joining in these programs.

Limitations

Despite our findings, some limitations exist in our research. Sending our survey to only current ENERGY STAR partners did not allow for a control group. In the presence of a control group, it would have been possible to examine why the firms in specific product categories did not join ENERGY STAR and use this information in targeting more firms.

Our research evaluated 14 of 33 current ENERGY STAR product categories Further research could evaluate the remaining product categories such as appliances, compact fluorescent bulbs, and water coolers. Additionally, new product categories are being introduced annually. In 2001, for example, more than 5 new product categories were introduced including dehumidifiers and ceiling fans.

Moreover, our response rate provided us with a rather small sample size, which caused the exclusion of some product categories from the category-specific statistical analysis. Furthermore, it would have been beneficial if the EPA had provided us with complete records on the joining dates for all product categories in order to obtain a more detailed picture of the rate of joining.

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