The Role of Values and Lifestyles in Consumer Adoption of Natural Gas End-Use Technologies

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Previous studies have indicated that noneconomic factors, such as convenience, quality, security, and prestige, are increasingly important in consumer purchasing decisions. However, analyses to date-- including both econometric and engineering models--have not explicitly considered these noneconomic factors. Such analyses are thus no longer adequate tools for understanding consumer preference and choice. This is clearly the case in the area of energy end-use technology purchases, in which noneconomic considerations are often dominant. SRI International's (SRI's) study represents a pioneering effort to evaluate these noneconomic factors systematically and to quantify their effects on consumer purchasing decisions. Specifically, it uses SRI's Values and Lifestyles (VALS) system to develop a preliminary market assessment model for projecting consumer adoption of natural gas end-use technologies. In summarizing the SRI study, this paper describes the technology market assessment model and illustrates its application to one selected existing natural gas end-use technology. It thus demonstrates the methodology for using consumer values and lifestyles data to improve projections of consumer purchasing behavior.

Introduction

As the research arm of the natural gas industry, the Gas Research Institute (GRI) has key responsibilities in the R&D planning and management of technologies that promote productive and efficient use of natural gas. To assure the value of its programs and products, GRI has made market assessment a prerequisite of its research planning process.

For a market assessment of industrial end-use technologies, econometric models can often approximate the preference and decision process of large corporations. However, these models have not proven highly productive in defining the technology preferences and choices of consumers or of proprietors of small businesses and industries. For example, although theoretically interesting, the hedonic demand model of consumer choice has found little application. A major reason for this model's lack of success is its reliance on observed market data rather than on an understanding of consumer values and lifestyles—an understanding SRI has found to be crucial to the formulation of reliable projections of consumer choice.

To help GRI assess market potentials of future technologies more accurately, SRI used its VALS system to explore systematically and quantitatively the effect of values and lifestyles on consumer adoption of natural gas end-use technologies. The test case problem was the need to understand why the sales of a selected high-quality high-performance natural gas end-use technology were large, given its pricing at approximately 150% greater than technologies of comparable performance. The product can in the long run generate savings equal to its initial cost, but these savings are generally about 10 years in the future--too remote to have a pivotal influence on the purchase decision. On the basis of purely economic and performance analysis, a product this much more expensive than its competitors would have little market. Yet in the study timeframe it had sold well. *The VALS segmentation system provided a means of differentiating the consumer purchase decision beyond just direct economic and performance analysis.*

The SRI Values and Lifestyles System

In 1978, SRI launched its Values and Lifestyles program, which uses social psychology theory to characterize groups in the U.S. population on the basis of their values, attitudes, needs, wants, beliefs, and demographic characteristics. The 1987 revised VALS 2 program categorizes American consumers into eight segments or types, each showing a distinctive pattern of preferences in relation to media, consumer goods, and lifestyle activities. These eight segments—Actualizers (AZ), Fulfilleds (FU), Believers (BE), Achievers (AC), Strivers (SV), Experiencers (EX), Makers (MA), and Strugglers (SG)—emerged from an analysis of demographic information and personal attitudes, such as, "I like to try things that are new and different." The eight groups (see Figure 1) also mark the
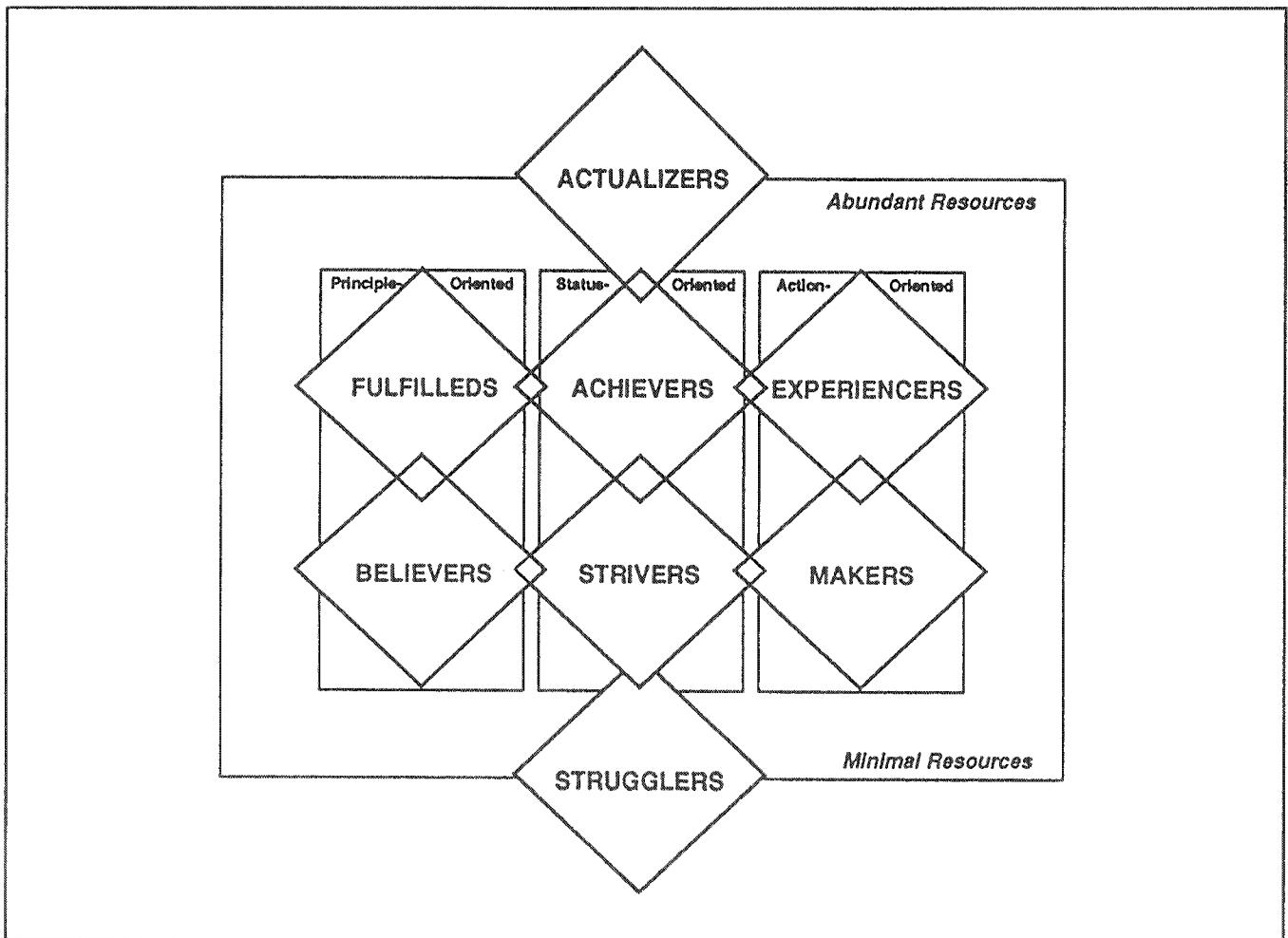
ACTUALIZERS

Abundant Resources

Principle- Oriented | Status- Oriented | Action- Oriented

FULFILLEDS | ACHIEVERS | EXPERIENCERS

BELIEVERS | STRIVERS | MAKERS

Minimal Resources

STRUGGLERS

Figure 1. The VALS 2 Segmentation

extremes of two basic social dimensions: *resources*, which influence a person's level of involvement in consumer purchases, media, and recreational activities and *life orientation*, which identifies the kinds of activities or information a person finds most rewarding or gratifying.

The VALS 2 segments are identified through answers to a 42-item questionnaire, which Mediamark Research, Inc. (MRI) and the Simmons Market Research Bureau (Simmons) include in their annual surveys of more than 20,000 consumers. These large national samples provide the basis for detailed understanding of the activities and preferences of the VALS 2 groups. At the same time, the VALS 2 system provides a framework in which to analyze and compare very different media and consumer markets.

In addition to other marketing applications, the VALS system has been used extensively in assessing the market potential of many energy-efficient products, including thermal windows, weather-stripping, insulation, energy-saving light bulbs, automatic setback thermostats, solar heating, and heat pumps.

Method of Approach

To assess the market potential of a new product, the VALS system translates the product's observable features (e.g., technical, sensory, and economic) into perceived customer benefits or uses (e.g., performance, product image, user image). VALS then projects the perceived benefits into degrees of product adoption by various consumer types in the future.

In the GRI project, SRI's method for validating the VALS system's applicability to market assessment was through a market backcasting study that analyzed consumer adoption of an existing natural gas end-use technology. The technology was a high-priced, high-quality, high-performance

major home appliance. The four tasks of the study are outlined below.

Study Design and Technology Selection

SRI worked with GRI to define the requirements and the expected results of the backcasting study. To do this, they jointly selected an existing high-priced, high-quality, high-performance natural gas end-use technology, of sufficient complexity to allow adequate values and lifestyles characterization.

Technology Characterization

The second task defined the detailed features of the selected technology. The accuracy of SRI's market analysis depends on the thoroughness and accuracy of this characterization. The VALS program requires information on product attributes, pricing, marketing, consumer financing, performance characteristics, compatibility with existing infrastructure, and so on.

Consumer Characterization

This task defined the geographic and demographic parameters of the consumer population of the backcasting study. Information on such parameters is an important element of the study, because in addition to values and lifestyles, geographic and demographic information plays a role in consumer choice.

Market Backcasting

On the basis of the features of the selected technology and the characteristics of the target consumer population, SRI used the VALS data base to conduct a retrospective estimate of consumer adoption of this technology. Because of the test-case nature of the study, SRI used simple estimates of econometric and time dynamic parameters, such as price and income elasticities and market penetration rates.

Results of the Study

The market backcasting study results include an initial analysis of national market potential—using only qualitative information from local dealers of the selected technology—and a more detailed analysis of both national and regional market potentials using sample demographic profiles of the purchasers of the selected high-priced, high-quality, high-performance natural gas end-use technology together with the geographic distribution of overall

purchases of the high-performance generic technology with natural gas, which includes the selected technology.

The Initial Analysis

SRI conducted the initial analysis in the following six sequential steps.

(1) The analysis base was restricted to include only (a) home owners (b) with 1 or more years of college education (c) with gross household incomes of more than $40,000. We based these exclusions on the qualitative information from local dealers on the purchasers of the selected technology. The analysis base excluded commercial and rental properties and new home construction as significant components of the market. Within this group, some college education was considered consistent with interest in state-of-the-art technology, and the household income had to be sufficient to afford a high-priced product. This sampling frame defined a base of about 3.15 million households.

(2) Within this base, the VALS 2 system targeted those consumers who are drawn to well-engineered, high-quality products. Analysis of purchase patterns across a variety of consumer goods shows that these consumers are most often Actualizers, Fulfilleds, and Achievers (with the first two groups usually predominating). These VALS segments identify the informed and self-confident consumer--aware of new products and willing to make independent product choices on the basis of objective information.

According to the 1989-1990 Simmons data, this base contains 903,000 Actualizers, 902,000 Fulfilleds, and 1,035,000 Achievers (2,840,000 total). This suggests an ultimate total market for the selected technology in the United States of about 2.8 million consumers. Assuming a replacement cycle of about 20 years for the generic technology, the average annual replacement sales would be approximately 142,000 units.

This restriction does not assume that the three VALS 2 segments will only buy the selected technology; instead, it assumes that sales of the selected technology to the excluded segments will be insignificant.

(3) Data on related home repairs--roofing, thermal windows, central heating or cooling, or kitchen improvements--can indicate whether these three segments are more or less likely than average to own older homes (more in need of repairs or renovations) or to initiate discretionary home improvements. Overall, these segments are within 90% to 110% of the

national average on most of these indicators, which eliminates the need to adjust the segment proportions to reflect different rates of home repair.

(4) The selected technology is a new product, and consumers with access to new product information most likely adopted it first. In this case, such information would come from niche media and product sales representatives. On the basis of the home repair rates just cited, we can assume an approximately equal rate of appliance breakdowns and/or new appliance installations across all three VALS 2 segments--which would be the immediate avenue for learning about the product from appliance suppliers.

Differentials might occur because of differences in use of print media. However, for magazines related to home improvement or consumer products, Achievers read media at about the same rate as Actualizers or Fulfilleds, so again no correction is necessary for differences in media exposure across segments.

(5) We can probably assume a higher rate of selected technology purchase among media-aware buyers. On the basis of Simmons data on magazine readership for media likely to carry information about the selected technology as part of home improvement or consumer product information, an audience of 605,000 exists for such information--about 21.3% of the annual replacement market in the restricted base.

The amount and quality of information these magazines carried about the selected technology is unknown. Most persons with broken appliances hear about the selected technology from a contractor (the sales pressure applied in this situation is another unknown, but we assume it to be nonexistent). Prior media exposure (or corroborating media information) will, however, enhance product acceptance and raise market share.

(6) Not all persons exposed to information on the selected technology will buy it; many will choose a less expensive replacement alternative. Local dealers report that the selected technology is about 150% more expensive than competing technologies, though it can generate energy savings equal to the initial price in about 10 years.

Current cash flow, disposable assets, and planned tenure in the home all play a role in economic deliberations. However, if we assume that these have little effect (because we have a prequalified base that can afford the technology), and if we assume a simplistic relationship of price to market share that the ratio of

market shares is inversely proportional to the ratio of prices, disregarding payback efficiencies, then the selected technology should expect to capture about 40% of the total replacement sales, or about 56,800 units annually. Media exposure will enhance this share in about 21.3% of the market. Assuming at the extreme that it doubles the likelihood of a technology choice (a very high media impact), then the net units sold after media exposure would rise to a total of about 68,900 units annually (about 49% of the total market). The final high estimate of the total potential annual market for the selected technology is therefore about 69,000 units.

The Detailed Analysis

The detailed analysis used (1) income distribution of households using the generic technology with natural gas, (2) regional distribution for the markets of the high-performance generic technology with natural gas, and (3) sample purchaser profiles obtained from the manufacturer of the selected high-priced high-quality high-performance natural gas end-use technology.

Technology Purchaser Profiles. The purchaser profiles confirm that the selected technology purchasers are home owners (99.4%) and that commercial or rental properties and new home construction are not significant components of the selected technology market. Purchasers include households with widely dispersed gross incomes--from less than $20,000 to more than $100,000--a lower starting point than the $40,000 restriction used in the initial analysis. The profiles do not include specific data on education. Exactly 50% of the purchasers are married, over 45, with no children in the home; purchaser median age is 56. The occupational and recreational profiles suggest a consumer group that is well educated (disproportionately more professional and managerial occupations) if the purchaser is employed, and physically active if the purchaser is retired.

The profiles also show that almost 57% of purchasers first heard about the selected technology through product sales representatives (in this case, contractors licensed to install the technology) or from friends; another 16% first heard about it through television advertising. The dominant factors influencing the purchase decision clearly involved personal recommendations from the contractor, friends, or a manufacturer representative.

Without additional knowledge of the purchasers, we use information in Simmons data to develop a set of Media Weights to represent such influence. Specifically, we estimate the Media Weight of each VALS 2 group by the

proportion of the group that has read in the past year any of a wide selection of magazines (including *Architectural Digest, Barron's, Home, Money, 1001 Home Ideas, Practical Homeowners*). The magazines were chosen because they had a high overlap with the audience base of *Consumer Reports* and therefore targeted consumers likely to make information-based purchases, and because they emphasized home or financial matters in either editorial or advertising content. These magazines proxy for consumer "information acquisition," since Simmons has no data on using word-of-mouth or personal references to choose home durables.

Constructing Market Projection Tables. The regional market projection is more intricate than the simple national projection in the initial analysis. This section explains the 8 steps of the standard layout, using the computations for market potential in the East Central United States as an example. Computations for market potential in the other four regions (Northeast, West Central, South, Pacific) are identical in design.

(1) The projected frequencies for "own single-dwelling households" are tabulated directly from Simmons 1991 consumer survey, using the eight VALS 2 groups and 18 household income categories in Table 1.

(2) Not all Simmons consumer survey households filled out the VALS 2 questionnaire. Therefore, the total of all VALS 2 groups in each income category will not sum to the total number of the region's actual households in that income category. Column R1 in Table 1 gives the ratio in each income category of the number of actual households and the number of VALS households.

Table 1. Own Single-Dwelling Households by Income and VALS Groups in Simmon's Database

Region: East Central

Income	Actual Total	Actualizer	Fulfilled	Believer	Achiever	Striver	Experiencer	Maker	Struggler	VALS Total	R1	D1 Percent of Total	D2 User Percent	R2
$5K	175	0	0	41	0	0	0	0	66	107	1.636	2.0		0.686
$5K-$7.5K	541	0	20	78	0	10	16	34	203	361	1.499	6.1		0.686
$7.5K-$10K	451	1	24	67	0	33	0	4	190	319	1.414	5.1		0.686
$10K-$12.5K	379	0	11	62	0	9	0	18	131	231	1.641	4.3		0.686
$12.5K-$15K	386	0	14	74	0	6	9	52	113	268	1.440	4.3		0.686
$15K-$20K	511	3	26	155	0	41	17	20	109	371	1.377	5.7	18.8	0.686
$20K-$25K	594	2	60	94	0	87	36	75	64	418	1.421	6.7		1.181
$25K-$30K	757	25	50	126	0	111	25	119	32	488	1.551	8.5	17.9	1.181
$30K-$35K	795	27	80	159	13	130	10	119	31	569	1.397	8.9		1.175
$35K-$40K	570	26	86	66	7	93	24	79	26	407	1.400	6.4	18.0	1.175
$40K-$45K	656	34	57	95	77	101	8	46	0	418	1.569	7.4		1.198
$45K-$50K	512	40	44	66	82	77	18	44	0	371	1.380	5.7	15.7	1.198
$50K-$60K	1,007	39	110	78	287	24	50	58	0	646	1.559	11.3		0.917
$60K-$75K	810	106	85	43	139	9	39	55	0	476	1.702	9.1	18.7	0.917
$75K-$100K	517	139	67	9	154	0	12	0	0	381	1.357	5.8	5.8	1.000
$100K-$150K	184	38	11	0	61	0	1	0	0	111	1.658	2.1		1.811
$150K-$250K	31	7	7	0	9	0	0	0	0	23	1.348	0.3		1.811
$250K+	36	5	9	0	2	0	0	0	0	16	2.250	0.4	5.1	1.811
Total HH	8,912	492	761	1,213	831	731	265	723	965	5,981		100.0		

R1 = Number of actual households/Number of VALS households
D1 = Distribution of households
D2 = National distribution
R2 = D2/D1

(3) Not all households use the generic technology with natural gas. Because we do not have regional distribution of households using the generic technology with natural gas, we use the national income distribution for households that do use the generic technology with natural gas, shown as "User Percent" in Table 1, as the basis for adjustment. Column R2 in Table 1 gives the ratio in each income category of the national income distribution of households using the generic technology with natural gas and the actual income distribution of households in the East Central United States.

(4) By multiplying Columns R1 and R2 of Table 1 into the initial VALS 2 group distribution, we obtain the adjusted VALS 2 group distribution for total households in Table 2, *if all households had used the generic technology with natural gas.* Since only about 50% of the households use the generic technology with natural gas, the number of such households for each VALS 2 group is shown as "Gas Appliance Total" in Table 2, obtained by multiplying the total number of households ("Total HH" in Table 2) by 0.5.

(5) The Sales Weight in Table 2 reflects the proportion of total 1990 sales of generic technology with natural gas in each region that were high performance product sales (obtained from a national trade organization's data base). Because we do not have sales data by

Table 2. Adjusted Household Distribution and Gas Technology Purchases

Region: East Central

Income	Actualizer	Fulfilled	Believer	Achiever	Striver	Experiencer	Maker	Struggler	VALS Total
$5K	0	0	46	0	0	0	0	74	120
$5K-$7.5K	0	21	80	0	10	16	35	209	371
$7.5K-$10K	1	23	65	0	32	0	4	184	309
$10K-$12.5K	0	12	70	0	10	0	20	147	260
$12.5K-$15K	0	14	73	0	6	9	51	112	265
$15K-$20K	3	25	146	0	39	16	19	103	350
$20K-$25K	3	101	158	0	146	60	126	107	701
$25K-$30K	46	92	231	0	203	46	218	59	894
$30K-$35K	44	131	261	21	213	16	195	51	934
$35K-$40K	43	142	109	12	153	40	130	43	670
$40K-$45K	64	107	179	145	190	15	86	0	786
$45K-$50K	66	73	109	136	127	30	73	0	613
$50K-$60K	56	157	112	410	34	71	83	0	924
$60K-$75K	165	133	67	217	14	61	86	0	743
$75K-$100K	189	91	12	209	0	16	0	0	517
$100K-$150K	114	33	0	183	0	3	0	0	333
$150K-$250K	17	17	0	22	0	0	0	0	56
$250K+	20	37	0	8	0	0	0	0	65
Total HH	831	1,207	1,717	1,363	1,178	400	1,127	1,089	8,912
Gas Appliance Total	416	604	859	681	589	200	563	544	4,456
Sales Weight	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	
High Performance Total	96	139	198	157	136	46	130	126	1,029
Media Weight	0.294	0.162	0.039	0.140	0.081	0.111	0.066	0.055	
Selected Technology Total	35	28	10	28	14	6	11	9	140

VALS 2 types, we have used the regional average for all VALS types.

(6) The concept of the Media Weights, which vary among VALS 2 groups, and their estimation process are discussed in the Technology Purchaser Profiles section.

(7) The Sales Weight is based on historical purchase data and therefore gives a high probability estimate of the total number of possible consumers in each region each year. However, the Media Weight is only a guess at the proportion of the selected technology consumers likely to use information to a high degree in product purchase. We also need to estimate how many consumers bought the selected technology who *are not* high print media consumers. This is an estimate of the actual market share for the manufacturer and its high-information, contractor-recommendation sales strategy.

We will use the East Central region as an illustrative example of the computations. The Media Weight for Actualizers in Table 2 is 0.294--indicating that about 29% of Actualizers in the East Central United States read at least one of the many magazines listed in Step 6. However, if these represent only 80% of the actual Actualizer purchasers of the selected technology, the proportion should be 0.368--that is, 0.294 times the reciprocal of 0.80. The number 80%, in this case, is a guess at how far off the media information is as an estimate of the proportion of each VALS 2 segment that bought the selected technology on the basis of manufacturer recommendation.

We have used 0.80 as a preliminary estimate for this media probability in all cases.

(8) Using the adjusted VALS group distribution in Table 2, we can obtain the ultimate market potential of the selected technology in each VALS 2 group as follows:

Ultimate market potential of the selected technology in group i

= Gas appliance total in group i x Sales Weight x Media Weight / Media Probability

The ultimate market potential for the region is obtained by summing over all VALS groups, which is 140,000 units for the East Central United States.

Projections. The 1991 ultimate market potential projections, by region, are as follows:

Total high-performance natural gas generic technology purchasers

East Central (KY, OH, MI, IN, WV)	1,029,000
Northeast (ME, NH, VT, MA, NY, NJ, PA, CT, DE, DC, MD, RI)	1,145,000
West Central (MN, IA, ND, SD, MT, ID, WY, CO, KS, IL, MO, NE, WI)	1,760,000
South (TX, OK, AR, MS, GA, FL, SC, NC, VA, AL, LA, TN, NM)	373,000
Pacific (AK, AZ, CA, OR, WA, ID, NV, UT)	268,000
Total	4,575,000

Selected technology purchasers

East Central (KY, OH, MI, IN, WV)	140,000
Northeast (ME, NH, VT, MA, NY, NJ, PA, CT, DE, DC, MD, RI)	164,000
West Central (MN, IA, ND, SD, MT, ID, WY, CO, KS, IL, MO, NE, WI)	261,000
South (TX, OK, AK, MS, GA, FL, SC, NC, VA, AL, LA, TN, NM)	55,000
Pacific (AK, AZ, CA, OR, WA, ID, NV, UT)	85,000
Total	705,000

On the basis of these 1991 projections, if we assume a replacement cycle of about 20 years for the generic technology (verified by the purchaser profile), then the average annual sales of the high-performance generic technology with natural gas will be approximately one-twentieth of 4,575,000 or 229,000 units, while the average sales of the selected technology will be about 35,300 units annually.

These projected estimates are within the same order of magnitude as the actual 1990 sales of the high performance generic technology using natural gas and of the selected technology respectively.

Discussion

This preliminary study indicates that purchaser values and lifestyles played an important role in the sale of the selected technology. The image of this technology as a high quality, conservation-oriented, "best" product appealed to specific segments of the population, and the product's media exposure influenced these segments as well. The purchase was therefore based on more than simple price and performance considerations, and the complexity of such consumer decisions encourages the use of a differentiating market survey system such as VALS.

Many refinements of the analysis are possible. For example, we can improve the accuracy of the projections by using regional income distributions of households using generic technology with natural gas and sales data of high-performance generic technology with natural gas. However, the simple approach used in the current analysis is sufficient to indicate the order of magnitude of the market potential for a technology with specific characteristics that are important to different VALS groups.

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