Willingness to Pay for Electricity from Renewable Energy

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The public clearly prefers the idea of developing and using renewable energy over other energy alternatives. Utility companies, in the face of anticipated restructuring and increasing competition, are exploring how to aggregate widespread consumer preferences for electricity generation from renewable energy to protect and improve the environment. So-called "green-pricing" programs attempt to capitalize on these preferences, and on an expressed willingness to pay (WTP) more for environmental protection, through a variety of schemes designed to encourage electricity customers either to pay a premium for renewable electricity or to contribute a voluntary pledge paid with their utility bills for the purchase of supply-side renewable energy.

This paper summarizes national data on public preferences for renewables and WTP for electricity from renewable sources, results from utility market studies on WTP for renewables and green-pricing program features, and experience with selected green-pricing programs. It draws inferences for program design and future research.

INTRODUCTION

Background

Public concern about the environment has increased during the past 12 years, and increasing majorities of the public have, in national opinion polls, selected renewable energy and energy efficiency over other energy alternatives. In addition, national surveys show that majority concern for environmental protection extends even to personal costs. People seem willing to "Put their money where their mouths are" at least up to a point. To protect and improve the environment, majorities in most surveys indicated a willingness to pay more for taxes, gasoline, electricity, other fuels, and automobiles. These survey items address institutional, rather than behavioral,¹ responses to environmental protection. That is, they address willingness to pay (WTP) for actions on the part of government, the oil industry, utility companies, and automobile manufacturers.

Are the two trends—increasing environmental concern and preferences for renewables—linked? Evidence suggests that they are. Public preferences for policies and programs supportive of the development and use of renewables appear to be linked with perceived positive effects of renewables (including environmental protection) coupled with perceived negative effects of other energy alternatives. The salience of these strong preference trends as expressed in actual behavior, such as voting and purchasing renewable power, remains to be explored. Nationally, widespread preferences for renewable energy, and the reasons for it, suggest that large segments of utility customers might constitute a potential market for renewable electricity. But, there is a long distance between expressions of preference in the abstract and participation in a green-pricing program or directly purchasing renewable energy systems. Covering that distance depends on the actions of product manufacturers, utility companies, policy makers, and others involved in offering products to the buying public. This paper explores the utility option of green pricing as a method of aggregating public preferences for renewables.

The green-pricing concept is based on the notion that premiums and contributions are needed to pay for renewable electricity generation because, at least in the short run, the cost of generating electricity from renewables is higher than the cost of generating electricity from such fuels as coal and natural gas. Green-pricing programs give customers the option of purchasing renewable energy at a higher price. Customers pay a monthly premium for a specific product or contribute more on their utility bills so that their utility companies can purchase renewables for electricity generation in the future. The issue of comparative generating costs and costing methods is beyond the scope of this paper. Utilities, in an increasingly competitive environment, are interested in exploring the potential for green-pricing programs to build customer satisfaction and loyalty, even among those not participating in green-pricing programs. Some utilities have conducted market research in their service territories on WTP for renewable electricity; some have conducted field tests and simulations; and some have actually fielded green-pricing programs.

Scope

This paper reviews the widespread national public support for renewable energy and WTP for environmental protection. It then reviews the available utility market research in local utility service territories on WTP, preferred characteristics of green-pricing programs, and projected levels of participation in such programs. Field-tested green-pricing programs and their participation rates are described, and implications for future research and green-pricing-program design are discussed.

METHODS

This analysis is based on work that updates earlier studies identifying patterns of public opinion about energy. Items that are included in this paper represent patterns of response found in a set of data from more than 700 polls of national probability samples. This secondary analysis relies on poll data from library collections, polling organizations, and the Roper Center for Public Opinion Research database (accessed through the DIALOG Information Retrieval Service). The national data examined were derived from probability samples of U.S. adults, registered voters, or electricity customers queried by major polling organizations, such as Roper, Harris, Gallup, and Cambridge Research. In addition, to collect utility market data, we contacted utility market analysts and requested copies of their studies. We also reviewed published articles and contacted utility managers of green-pricing programs to gather program descriptions and information on their experience with green-pricing programs.

U.S. PUBLIC PREFERENCES FOR RENEWABLE ENERGY AND WILLINGNESS TO PAY FOR RENEWABLE ELECTRICITY

An analysis of poll data from 1979 through 1992 offered considerable evidence that, when other energy alternatives are included in survey items and cost or price information is not, renewable energy and energy efficiency have been the public's preferred energy alternatives (Farhar et al. 1979, 1980; Farhar 1993; Farhar 1994). The data showed a decrease in public preferences for fossil fuels (except natural gas) and majority opposition toward further implementation of nuclear energy. A key question is: Has this trend continued despite the changes in the political climate expressed in the 1994 congressional election? Evidence shows that it has. Results from national surveys since the 1994 election show continued public preferences for efficiency and renewables over other energy alternatives. Some examples reflecting this trend are presented here.

In December 1994, RSM, Inc. (Breglio 1994) asked a national probability sample of registered voters: "If the government is to continue funding for research and development for specific energy sources, which source do you think should be highest priority? Renewable energy, like solar, wind, geothermal, biofuels, and hydroelectric; energy efficiency and conservation technologies; nuclear energy; fossil fuels like oil and coal; or natural gas? And which source do you think should be the second highest priority?" A plurality of 42% selected renewable energy as highest priority; 22% selected energy efficiency and conservation; 15% natural gas; 9% nuclear energy; 7% fossil fuels (oil and coal); and 6% did not know. When asked their second choice, 27% selected energy efficiency and conservation; 22% renewable energy; 20% natural gas; 12% fossil fuels; 12% nuclear energy; and 7% did not know. Eighty-five percent of the respondents agreed that "The federal government should continue to support partnerships with American business to promote sales of energy efficiency and renewable energy technologies through research and development and programs to open new domestic and international markets." Political party affiliation made no difference in preferences for renewables and efficiency.

A year later, in December 1995, RSM, Inc. again asked registered voters which of five energy research and development programs should receive the highest priority for funding in DOE's budget as Congress and the Administration worked to reduce the federal deficit (Sustainable Energy Budget Coalition 1996). A plurality of 34% selected "renewable energy involving solar, wind, geothermal, biomass, and hydroelectric power"; 21% "technologies to improve energy efficiency and conservation"; 9% selected each of nuclear power, fossil fuels (such as oil, gasoline, and coal), and natural gas; and 19% did not select any of the choices.

This pattern of public preference for the development and use of renewable energy continues a trend of some 18 years' duration—one of the strongest patterns and longest-lasting trends observed in the entire data set on public preferences on energy and environmental policy. But the question remains: Will products and services be created that will satisfy the public preference for the development and use of renewable energy?

Why does the public prefer efficiency and renewables? Concern for the environment has been increasing (Dunlap 1991; Dunlap and Scarce 1991; Farhar 1994). Energy-supply preferences seem increasingly to be environmentally driven (Farhar 1994). Preferences for renewable energy and energy efficiency are consistent with increasing energy-related environmental concerns (such as the greenhouse effect, oil spills, nuclear accidents, and radioactive waste disposal problems). This trend appears to be continuing. For example, in July 1994, 61% of a national sample believed that the following statement was ''definitely true'' or ''probably true'': ''Every time we use coal or oil or gas, we contribute to the greenhouse effect'' (National Opinion Research Center 1994). Concern for the environment is not the only reason for preferences for renewable energy. In July 1993, a national sample was asked: "I'm going to read you a list of sources for energy. Then I'll give you a description and I'd like you to tell me which one energy source from the list you feel most closely matches that description. The energy sources are: solar, oil and gasoline, natural gas, nuclear, hydroelectric (water power), and coal. Now, of those energy sources I just listed, which one do you feel is ...?" (Wirthlin Group 1993). Table 1 shows the results.

What have polls shown about the overall willingness to pay for environmental protection and renewable electricity? In several national polls, majorities of 57% to 80% said they were willing to pay more for electricity produced in a cleaner way or from sources less harmful to the environment (studies cited in Farhar 1994). Laboratory experiments show that subjects using real money will contribute between 20% and 40% of their true WTP for provision of a public good (studies cited in Schulze 1994). Individuals exhibit a natural tendency to cooperate to make everyone better off, even though each individual has an incentive to ride free. Percentages expressing WTP tend to be higher from surveys (which reflect hypothetical situations) than in real situations. Traditional market research methods can test acceptability of alternative product offerings but cannot test alternative mechanisms for overcoming free riding (Schulze 1994).

In 1993 and again in 1994, the National Opinion Research Center asked: "How willing would you be to pay much higher prices in order to protect the environment?" Table 2 shows the findings from the 2 years.

In September 1990 and again in May 1994, Cambridge Reports/Research International asked: "How much more would you personally be willing to spend each month to have your electricity come from sources that are less harmful to the environment?" The response options prevent discerning those who would pay nothing at all, because the first option was \$0 to \$5. Table 3 shows the trend in responses.

These data show that pluralities still express WTP to protect the environment and to generate electricity from environmentally beneficial sources; however, they also suggest that percentages expressing WTP may have decreased slightly in the 4 years from 1990 to 1994.

In May 1995, the Harris poll asked: "How willing would you be to pay somewhat higher electricity costs if you knew the money would be spent to protect and restore endangered

Factor	Solar	Hydro- electric	Natural gas	Oil & gasoline	Nuclear	Coal	Don't know
Best for environment	55	22	12	3	3	3	2
Safest	50	24	12	3	2	6	3
Most abundant	29	18	16	15	6	11	4
Makes the U.S. most self-reliant	22	16	18	8	20	9	7
Least expensive	32	17	19	6	4	15	6
Best for U.S. economy	25	18	19	15	11	7	5
Most positive for you	34	22	22	11	5	3	3
Will play increasing role in 21st century	43	8	8	6	29	1	5
Source: The Wirthlin Group (1993)							

Table 1. Percentages showing comparative preferences for energy sources on several factors, 1993

Table 2.	Percentages	willing to	pay	higher	prices to
p	rotect the en	vironment	, 199	93–1994	4

Willing to pay	1993	1994		
Very willing	11	9		
Fairly willing	42	37		
Don't know/Neither	25	27		
Not very willing	15	17		
Not at all willing	7	9		
Source: National Opinion Research Center (1994)				

 Table 3. Percentages willing to pay more for less

 environmentally harmful electricity, 1990–1994

Amount more willing to pay	9/90	5/94		
\$0–5/month	22	40		
6–10	29	20		
11–20	21	18		
21+	26	22		
Source: Cambridge Reports/Research International (1994)				

species—very willing, somewhat willing, not very willing, or not willing at all?" Sixty-one percent said they would be "very" or "somewhat" willing; 39% would be unwilling to pay higher electricity costs for this purpose.

In May 1995, Cambridge Energy Research Associates and Opinion Dynamics Corporation reported that 20% of electricity customers said they would pay a 30% premium for solar electricity (*Solar Letter* 1995).

In December 1995, RSM, Inc. asked "Suppose you have the chance to choose your electric company the same way you now can choose your long-distance telephone company and the choice were between a utility company that uses coal to generate electricity and a utility company that produces electricity with cleaner, but slightly more expensive, renewable energy sources. Of the following, which indicates how much more you would be willing to spend per month for electricity generated from cleaner renewable sources?" (Sustainable Energy Budget Coalition 1996). A plurality of 49% said they would pay at least up to 2% a month more; 19% up to 10% more; and 8% more than 20% more. Twentyfour percent said they would not pay more and 1% did not know.

To summarize results from recent national surveys, approximately 40% to 70% indicate they would pay a premium for environmental protection or for renewable electricity. Byrnes et al. (1995) argued that opinion polls are in error because they found, in their Denver-area market research, much lower percentages actually willing to pay more for renewable electricity. We need to draw a clear distinction between results from national polls and local market research. The national poll data on preferences for renewable energy and WTP for environmental protection and for electricity from renewable resources should be interpreted as a generally favorable and long-standing public interest and a potential market that remains to be actualized. To put it another way, if majorities were indicating lack of interest in renewables and unwillingness to pay a premium for renewable electricity, utilities would not be interested in attempts to develop green-pricing programs. The poll evidence supports the notion that customers will notice and favor environmentally friendly electricity generation, whether or not they themselves participate in such programs. The specific percentages actually willing to participate in a given utility service territory should be defined by localarea market research.

DATA FROM UTILITY MARKET RESEARCH ON WILLINGNESS TO PAY FOR ELECTRICITY FROM RENEWABLES

Most market research conducted by utilities is considered proprietary; therefore, methods employed, sampling frames and methods, the questions used, frequency distributions of responses, and other analyses are generally not published. This makes it difficult to assess the quality of market research on green pricing. It also interferes with accumulating a reliable body of knowledge about green-pricing market research results that could help in program design and policy formulation. Utility market research may not be subjected to as rigorous a peer-review process as is more publicly available scientific research.

Nevertheless, by contacting numerous utility companies and perusing the literature, we were able to gather some market research information on green pricing from six utility companies. Although these studies usually do not present enough information on methods and responses to evaluate their quality, we include them for the information they have presented and for evaluation in the context of other findings presented in this paper and elsewhere. The six utilities are: (1) Sacramento Municipal Utility District, (2) Niagara Mohawk, (3) Portland General Electric, (4) Detroit Edison, (5) Massachusetts Electric Company, and (6) Public Service Company of Colorado.

Sacramento Municipal Utility District

A 1993 survey of Sacramento citizens showed that 26% of the general population expressed willingness to pay a 15% premium for PV electricity from their rooftops; 32% of EV Pioneers (electric vehicle owners); and 57% of the "green population" (Osborn and Collier 1994). The WTP percentages were higher when a 15% premium was offered with "rate stabilization"-49% of the general population, 55% of EV Pioneers, and 77% of the green population. Seventy percent of the general population, 74% of EV Pioneers, and 88% of the green population expressed WTP a 1%-10% premium "to establish a Clean Energy Program" (not necessarily on their rooftops). As part of its integrated-resourceplanning process, the Sacramento Municipal Utility District (SMUD) surveyed 800 residential, business, and industrial customers in February 1995. The results showed that 48% of residential, 49% of business, and 32% of industrial customers expressed WTP for "investments in renewable resources." Rating "promoting renewable energy production" as important were 72% of residential, 72% of business, and 32% of industrial customers. Willingness to pay more for SMUD to invest in renewable resources was measured for the different customer groups by percentage premium. Table 4 presents the results.

Table 4. Percentages of customers willing to paymore for SMUD to invest in renewable resources

Customer groups	Residential	Business	Industrial		
5% more	43	38	8		
10% more	27	20	0		
15% more	16	10	0		
20% more	7	3	0		
Source: Sacramento Municipal Utility District (1995)					

Niagara Mohawk

In 1994, Niagara Mohawk (NM) found that some customers were willing to pay up to \$10 a month more for renewable electricity "if they could see some common good from the program." NM concluded that only "green" customers appeared to place a significant value on NM buying renewable fuels or constructing renewable facilities. Green program characteristics favored were a fixed-amount payment for a green rate and a monthly or bimonthly rather than an annual payment. Customers also preferred flexibility-a 1to 3-year commitment or the ability to drop out at any time (Bauman 1994). A later telephone survey of 900 customers supplemented by conjoint interviews with a subsample of 116 showed the following results. Customers thought that using renewables to generate electricity was a good thing for NM to do, even if they didn't participate. "Green" respondents said they were more likely than others to pay a \$6/month premium for renewable electricity (mean score of 2.7 on a scale of 1–5 where 5 = very likely); at 3/month their mean score was 3.6. "Non-green" respondents scored 1.8 at \$6/month and 2.6 at \$3/month, respectively. The expected level of participation depended on awareness; for a period of 3 years at \$6/month at 10% awareness, 6% of the total population was projected to adopt. At 30% aware of the program, 19% of the total population was projected to adopt.

Portland General Electric

Portland General Electric (PGE) conducted market research on several green-pricing options to assess customer response. PGE examined three programs through market research (lock-in electric rates for wind; Oregon tax-free bonds; and affinity "Share-the-Wind" Visa credit card) and field-tested two approaches (the Share-the-Wind credit card and a program called the Penny Jar bill roundup program) (Weijo and Boleyn 1996). Based on the results, at 65% program awareness, PGE estimated the following market penetrations: 2% for lock-in electric rates; 1.2% for tax-free bonds; 1.3% for the affinity credit card; and 3% for the Penny Jar program. The researchers recommended that PGE offer a full line of green-marketing products with these four components to reach the maximum number of customers possible.

Detroit Edison

Overall, market research by Detroit Edison (DE) showed a 30% WTP \$10 to \$20/month more for renewable electricity, which translated to a projected 1% penetration. DE has not published market research results in detail, considering them proprietary.

Massachusetts Electric Company

Customer focus groups at Massachusetts Electric Company (MECo) showed enthusiasm for renewables and green-pricing concepts. However, customers were also concerned about costs, and some distrusted the utility's real motives for involvement. A subsequent telephone survey of 400 electricity customers showed that 49% expressed WTP at a 5% premium; 32% at 10%; and 13% at 20%. A follow-up mail survey of 100 customers (who said they would participate or didn't know) generated 15% who said they would definitely participate, and 24% who said they probably would (*Green Pricing Newsletter* 1995). Based on the market research, MECo has planned a green rate at 1¢/kWh over base rate, but the program was, as of May 1996, on hold because of corporate uncertainty about utility industry restructuring.

Public Service Company of Colorado

Focus-group research in 1992 established that Public Service Company of Colorado (PSCo) customers had strong feelings about the environment and the nation's natural resources. Telephone interviews tested program features. Respondents wanted more renewable energy development, but disliked the term "green pricing," which was associated with "green-marketing" efforts for other products. In response to these results, PSCo changed the program's name to "Eco-Option," then to "Voluntary Renewable Energy Program," and next to "Renewable Energy Assistance Project." By late 1995, PSCo referred to the program as the "Renewable Energy Trust Fund." In 1996, it became the "Renewable Energy Trust."

Contingent valuation (CV) methodology was used to predict customer participation in a PSCo green-pricing program at specified pricing levels (Baugh, Byrnes, and Jones 1994). Initial customer support was reflected in the 82% who said they were willing to pay \$1–\$4/month more to voluntarily support the development of renewable energy. At the first trials, 75% took registration cards to pledge \$2/month; 10% signed and returned the cards. The average per-customer participation cost was less than \$2/month or approximately 5% of an average customer's electric bill.

PSCo's program was viewed positively by more than 80% of respondents, regardless of their personal participation. Retrofit hydropower, photovoltaics (PV), wind, and solar thermal projects were "well accepted" (*Electrical World* 1993; Baugh, Byrnes, and Jones 1994). Respondents said that it was appropriate for PSCo to make a profit on a renewables program. A majority reportedly agreed that it was better to have PSCo develop renewables than the state or federal government.

In a critical review of the PSCo research, Marcus et al. (1995) said that the CV analysis used age and education as independent variables predicting WTP. The reasons underlying these analytic choices have not been made clear; other research would not necessarily support them. The PSCo market research did not describe the variables used in the analysis and did not report the variance explained. This prevented others from assessing the validity of the study's underlying assumptions and analyses.

Summary

Identifying segments of the population as green-pricing customers is not yet possible from the limited data and inconsistent findings available. More demographic analyses need to be completed for definitive patterns to emerge. Preliminary findings suggest that "green" customers (for example, those contributing or belonging to environmental organizations) are willing to pay more than others for fossil fuel replacement and environmental-benefit attributes (Bauman 1994). Green customers have higher adoption "probabilities" than others for renewables and emission-allowance programs (Bauman 1994). In addition, findings are mixed on the relationship of political ideology and age to WTP (see, for example, Energy Services Marketing Letter 1995 on the Niagara Mohawk findings that green-program participants are older). Income and education so far appear to be unrelated to WTP (for example, see the Solar Letter 1995 report).

Major problems exist in assessing the result of utility market research data.

- (1) Because such data are considered proprietary, the items used and the actual range of responses are rarely published. Instead, interpretations are published. Therefore, the scientific quality of the research and of the interpretations is impossible to assess because the publications describing the findings do not undergo rigorous peer review. In addition, the data are not cumulative.
- (2) Sometimes the interpretations offered generalize inappropriately to populations of electricity customers. For example, market researchers have, on occasion, generalized from percentages of focus-group participants expressing an opinion to the service-area population.
- (3) Often, sampling procedures are not described; therefore, the reader has no information on sampling criteria and sampling frames used. The generalizability of the findings cannot be assessed. Some writers have reported that they included only "green customers" in the study, but they then generalized results to the population of electricity customers in the utility's service territory. Such generalizations are inappropriate.

- (4) Programs described to respondents in market research may be actual or hypothetical. However, they may be designed more to meet the utility company's needs than those of the customer. If a low proportion of customers participate in a program, it may mean that the program was not designed with the customer in mind rather than that customers are not willing to pay for renewable electricity.
- (5) Question phrasing is often a problem. For example, asking respondents "Are you willing to pay more for electricity generated from renewable sources such as solar and wind power?" is different from asking them, "Will you pay \$5/month more on your utility bill each month so that XYZ utility can generate renewable electricity?"
- (6) Utilities may be missing other possible key motivators. Environmental protection is an important element of renewable electricity, but other factors such as health and safety can also play a part in favorability toward energy sources (for example, see responses in Table 1).

GREEN-PRICING PROGRAMS

The next issue to be addressed is the translation of the public's preferences and WTP into actual participation in programs that utilities are currently offering. Based on current market research and on the desire of utility decision makers to design programs that provide attributes customers value, utilities have implemented or are planning green-pricing programs that enable customers to pay a premium rate for specific renewables products or to contribute to the future siting of renewable power projects. The concept of green pricing was originally discussed by Moskovitz (1993); utilities have little actual experience with green-pricing programs, yet 24 utilities² have investigated the concept with several moving forward with implementation.

Utilities have taken two major approaches to program design: programs in which the utility (1) offers its customers a specific renewable electricity product at a premium price or (2) allows its customers an opportunity to contribute to a fund to be used in the future to pay for as-yet-unspecified renewable electricity projects.

Some utilities have programs that aim to develop renewables in general, whereas others focus on developing a single type of renewable technology. Still others support a specific project that the utility wishes to develop, but could not finance otherwise. Programs to date include both on- and off-grid applications for PV, wind, and geothermal resources and rates for both residential and wholesale customers. Table 5 briefly describes five residential green-pricing programs and Table 6 two wholesale customer green-pricing programs. Key program elements include length of customer commitment to the program, sense of exposure to risk, and perceived value added by the program. For further details on these programs, refer to Farhar and Houston (forthcoming).

Given the limited experience with these programs accumulated so far, the evidence suggests that programs in which customers pay a monthly premium for a specific renewable electricity product elicit a higher monthly financial commitment per customer than programs asking for contributions to unspecified future actions involving renewables. Table 7 summarizes the results from the 3 product-specific and 2 contribution programs for which data were available, contrasting average amount paid per month and kilowatt output. For residential programs in progress, the actual monthly payment is notably larger in product-specific programs in which customers pay a premium than in programs in which customers contribute amounts of their choosing to unspecified projects. However, to date the number of participants tends to be larger in the contribution-type programs. This has occurred, at least in part, because the product-specific programs have waiting lists of customers desiring participation.

Many other utilities are in various stages of green-pricing programs as well. These include Southern California Edison (CA), Florida Power Corporation, Florida Power & Light, Gulf Power (FL), Massachusetts Electric Company, Niagara Mohawk (NY), Snohomish County Public Utilities District (WA), Texas Utilities Electric, and Ontario Hydro. The programs and pricing schemes for the planned or implemented programs of these utilities are as varied as the examples described. Some of these utilities have programs underway, while others are in the research and planning stages.

CONCLUSIONS AND IMPLICATIONS FOR PROGRAM DESIGN AND FUTURE RESEARCH

Although experience with green pricing is still limited, some important implications for future research and design of green-pricing programs can be gleaned from the work accomplished to date. The questions facing utility planners about green pricing are: How many will subscribe, at what price, and for what products? (*Green Pricing Newsletter* 1995). Research shows that widespread customer interest is a given. Data from market research show that, although a willingness to pay more for renewable electricity is expressed, less than 10% will actually pay an increased monthly cost, at least initially (Marcus et al. 1995; Baugh, Byrnes, and Jones 1992).

Utility	Program	Notes
Sacramento Municipal Utility District	The PV Pioneers Program is a program in which customers pay a flat \$4 monthly fee over 1020years to have 4-kW grid-connected PV panel installed on their roofs.	Total participation as of January 1996 was 350 customers for a total of 121620kW, with 1000 new customers responses each year (Osborn and Collier 1996; McCorkle 1996).
Public Service Company of Colorado	The Renewable Energy Trust (RET) is a program in which customers make voluntary monthly pledges in support of the accelerated growth of renewables. This program includes the Round Up for Renewables Program in which the rounded-up portion of the customer's monthly bill is added to the Trust.	7,500 customers participate in the RET, at an average pledge of \$2 per month. \$112,000 has been collected and has been used to fund small stand-alone PV projects (Green Pricing Newsletter 1994).
Detroit Edison	The "Solar Currents" program offers solar energy service to residential and small commercial customers for an additional \$6.59 per month, on average, for each 10020watts of service from a planned 28.420kW PV facility.	Federal funding is being provided through the Utility Photovoltaic Group's TEAM-UP effort. As of January 1996, 248 residential and commercial customers had signed up to participate.
Traverse City Light and Power	Residential customers make a three-year commitment, while commercial customers make a 1020year commitment to pay a premium of 1.5820cents/kWh (approximately \$7.5020per month for residential) to fund construction of a 600-kW wind turbine. The program is scheduled to begin in early to mid-1996.	Participation is currently 260 out of 8,000 customers (Smiley 1995). An incentive for participation is a guarantee of no rate increases due to fuel cost increases over the period of participation.
City of Anaheim, City of Austin, AZ Public Service, Central & Southwest, Detroit Edison (mentioned above), NYSEG, Northern States Power, WI Public Service	These eight utilities are participating in the UPVG TEAM-UP PV Friendly Pricing program. They will install 34720kW of grid- connected PV systems on residential and commercial buildings. The projects will be financed using green-pricing schemes developed individually by each of the utilities.	TEAM-UP will be providing \$1.420million in funds to the eight utilities (National Renewable Energy Laboratory and Photovoltaics for Utilities 1995; The Solar Letter 1996).

 Table 5. Residential Customer Green-Pricing Programs (Actually Implemented)

It is not yet clear why there is a difference between expressed and actual WTP. Some hypotheses are that

- Customers' level of trust in their utility might interfere with their WTP (Marcus et al. 1995); customers may respond better to programs offered by municipal utilities rather than investor-owned utilities (Marcus et al. 1995)
- Customer segments may vary in WTP; "environmentprogram boosters" may accept somewhat higher premiums for renewable electricity, although other segments

(such as ''laissez-faire individualists'' and ''suspiciousinequity avoiders'') have also been willing to accept such premiums (Baugh, Byrnes, and Jones 1992).

• It may take a longer time for these programs to "mature" and penetrate the market than was originally expected by utility market researchers.

While these factors have been posited to affect customer participation in green-pricing programs, program features may influence customer response as well. Customers are

Utility	Program	Notes
Portland General Electric	A special tariff for a blend of green and conventional power is being marked to large wholesale and industrial customers. Two wind projects that PGE has contracted for will supply the renewable power—a 12.5-MW Columbia Hills project and a 25-MW Vansycle Ridge project.	Thus far, the City of Portland has signed a contract to purchase 11.220million kWh of green power during a 5-year period. This amounts to approximately 5% of the City of Portland's total power consumption. The city expects to save \$850,000 during the 5-year period as a result of this contract (Ohrenschall and Tansey 1995).
BPA	A green-power product is being marketed to the public utility districts. The program was set up to fund two wind and two geothermal projects.	A contract was signed with Salem Electric Cooperative to provide 7 average MW of green energy at 3520mills per/kWh. This agreement was made after the directors of Salem set a goa to have 17% of the utility's load served by renewable energy projects (Darr 1995; Oregonian 1996).

Utility	Number of participants	Amount of payment/ contribution per month	kW of renewables installed
Product-specific programs			
Sacramento Municipal Utility20District	350	\$4	1216
Detroit Edison	248	\$6.59/10020watts	28.4
Traverse City Light & Power	260	\$7.50 (1.58¢/kWh)	600
Contribution programs			
Gainesville Regional Utilities	1,600	\$3.32 on average	10–15
Public Service Company of 20 Colorado	7,500	\$2 on average	Small photovoltaic systems
Source: Citations provided in Table 6.			

 Table 7. Average Monthly Amounts Paid and Kilowatt Production, Product-Specific v. Contribution Green-Pricing

 Programs, 1996

more likely to participate the more they perceive programs as being:

• **Effective** in actually producing clean electricity, thus benefitting the environment (Weijo and Boleyn 1996; Bupp and Gorman 1995; Sacramento Municipal Utility

District 1995; *Green Pricing Newsletter* 1995; Baugh, Byrnes, and Jones 1992)

• **Directly advantageous:** not too expensive to participate; pay small amounts; pay even dollars (Weijo and Boleyn 1996; *Green Pricing Newsletter* 1995; Bauman 1994; Baugh, Byrnes, and Jones 1992); tax deductible (Weijo and Boleyn 1996); get return or profit; good investment (Weijo and Boleyn 1996); plan for the future; for children's future (Baugh, Byrnes, and Jones 1992); and avoid resource depletion (Harmon and Wind 1995; Baugh, Byrnes, and Jones 1992)

- **Customer risk reduction:** stability, consistency of long-term fixed rates (Weijo and Boleyn 1996; Bauman 1994; Osborn and Collier 1994; *Green Pricing Newsletter* 1995); customer and utility share the risk (Baugh, Byrnes, and Jones 1992); flexibility (cancelable, renewable, transferable); voluntary program (Weijo and Boleyn 1996; *Green Pricing Newsletter* 1995)
- Simple, easy to understand (Weijo and Boleyn 1996).

Because customers appear to respond more positively to programs that are well defined and tangible, utilities should be as specific as possible when designing and marketing a green-pricing program. Several utilities contacted said that programs focusing on a well-defined renewable energy project are apt to be more successful in gaining a higher level of customer cost commitment than those that are aimed at developing renewables in general. For example, the positive response by customers to SMUD's PV Pioneers Program seems to result, in part, from the fact that they can easily grasp and understand it. Once customers are aware of a program, based on the specificity of information they receive regarding what the program is intended to do, what is expected of them, and what the benefits of participating are, more of them may elect to participate. Utilities can add value by adding attributes, such as rate freezing, that further reduce perceived risk.

Flexibility can contribute to greater program success. Utilities should tailor their program to the needs of various customer groups because different customer groups perceive different value from various program elements. For example, residential customers may find it attractive if a utility can guarantee that rates will not increase due to fuel-cost increases, as in the case of Traverse City Light & Power's program. On the other hand, some large wholesale customers may perceive more value from a program that offers various price streams, as Bonneville Power Administration's (BPA) green-power product does. In each case, the utility tailored the program to meet the special needs of each customer group.

Public education is an important element in program success. The market research to date shows that consumers know little about how their electricity is generated and what the options for generation are (*Green Pricing Newsletter* 1995). Because customers tend not to think systemically about electricity generation primarily using coal and nuclear energy, they are hampered in evaluating the contribution of renewables to the energy mix. Public education is needed on energy mixes currently used and specific renewable resources that are available; programs already in place to deploy renewables; costs and benefits of renewables; and why utilities need to charge more for them.

How customers feel about their utility company could also influence their response to both market research questions and to green-pricing programs offered by a utility company. If a utility is trusted, for example, its customers might be more willing to sign on for green-pricing programs. Cambridge Reports/Research International (1994) reported trend data on favorability toward electric companies including eight data points collected between September 1990 and May 1994 from a national probability sample of electricity customers. After peaking in September 1993, favorability toward utilities declined back to 1990 levels (as of May 1994), although 71% were still favorable toward utilities in 1994. About half believed rates are fair, and that their utility company was concerned for its customers. Just over half considered their utility company "believable." Cambridge Reports said that many customers believed their utilities could perform better than they currently were in keeping rates low and in being less harmful to the environment.

Other factors could turn customers away from green-pricing programs, including skepticism about utility motives (*Energy Services Marketing Letter* 1995; Baugh, Byrnes, and Jones 1992) and the idea that green marketing is overused, as well as skepticism about whether the program would actually benefit the environment (Baugh, Byrnes, and Jones 1992).

From a utility perspective, advantages are that green pricing can permit a company to differentiate itself from competitors; build customer loyalty; improve relations with customers, regulators, and public interest groups; offer products and services that customers want; pursue a policy to reduce environmental pollution and expand the role of renewables; and use market solutions to achieve public policy goals, when possible (*Green Pricing Newsletter* 1995). One important barrier could be administrative costs, such as the cost of reprogramming the utility's billing system (on the order of \$50,000 to \$100,000 at one utility) to accommodate greenpricing mechanisms such as round-up programs (Weijo and Boleyn 1996).

Time is another crucial variable. Most of the experience with green pricing suggests that participation on the order of 1%-2% will occur within 2 years of program start-up. Participation will subsequently grow, but programs have not been around long enough to predict how quickly. Penetration rates will likely vary by customer segment and by the several program features mentioned above. Realistic expectations are that several years may be required to reach projected levels of participation and to institutionalize green-pricing programs. Useful future research will focus on testing various product configurations and tailoring products to the specific interests of likely residential, business, and industrial customers.

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ENDNOTES

- 1. Survey items addressing behavioral responses to environmental protection are those asking about people's recycling behavior, thermostat settings, use of mass transit, and the like.
- 2. These 24 utilities include Arizona Public Service Company, Sacramento Municipal Utility District (CA), Southern California Edison, Public Service Company of Colorado, Aspen Municipal Electric System (CO), Florida Power Corporation, Florida Power and Light, Gulf Power (FL), Gainesville Regional Utilities (FL), Massachusetts Electric Company, Detroit Edison (MI), Traverse City Light and Power (MI), Niagara Mohawk (NY), Portland General Electric (OR), Bonneville Power Administration (OR), Snohomish County Public Utility District (WA), Ontario Hydro, City of Austin Electric Utility (TX), City of Anaheim (CA), Central and Southwest Services (TX), New York State Electric and Gas, Northern States Power (MN), Wisconsin Public Service, and Texas Utilities Electric.

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