Consumer Willingness to Recycle Electronic Waste in California

[1]Hilary Nixon, [2]Jean-Daniel Saphores, [3]Dele Ogunseitan, and [4]Andrew Shapiro.

[1]Departments of Planning, Policy & Design, University of California Irvine
[2]Departments of Planning, Policy, Design, and Economics, University of California Irvine
[3]Department of Environmental Health, Science and Policy, University of California Irvine
[4]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, & Department of Chemical Engineering and Materials Science, UC-Irvine

The growing stockpile of used and obsolete consumer electronic devices (CEDs) has been called the "largest toxic waste problem of the 21st century" (Schmidt, 2002, p. A188). With technological advances, the average life span of the typical CED has dropped significantly in the past several years. In addition, more and more consumers around the globe are using an increasing number of CEDs. For example, the useful life of a cellular phone in the U.S. is approximately 18 months, a 50% decrease since 1995; during the same time period, the number of cell phone subscribers increased from 33.8 million to 140.8 million (Fishbein, 2002; Most, 2003). From public health and environmental perspectives, many of the components in electronic products are extremely toxic. Some of these hazardous materials include lead, cadmium, mercury, barium, beryllium, hexavalent chromium, plastics, polyvinylchloride, and brominated flame retardants. Electronic waste or "e-waste" management is a major concern and the issue is currently being debated at various levels of government and in the media.

The growth in the volume of e-waste is a problem; indeed, e-waste is one of the fastest growing components of the municipal waste stream in California and across the U.S. In a recent study, the EPA (2002) estimated that at least 2 million tons of selected consumer electronic waste is generated annually nationwide and over 90% is discarded; Due to data limitations, this number is considered to be an extreme lower bound. Precise data on the amount of e-waste generated, recycled, exported, and discarded is currently unavailable. In California, an estimated 6 million

obsolete computers and televisions are stockpiled in homes and more than 10,000 of these products become obsolete each day.

To try to address this problem, the Governor of California signed on September 24, 2003, the Electronic Waste Recycling Act (SB 20). This Act authorizes the collection of e-waste recycling fees at the point of sale and mandates a reduction in the use of hazardous substances in electronic products sold in California in accordance with regulations recently passed in Europe. In addition, California recently classified cathode ray tubes (CRTs) as Universal Waste so they can no longer be disposed in landfills; it is likely that other electronic products will be similarly classified in the future. A recent study of e-waste diversion in California for CRTs indicates, however, that the current recycling infrastructure is inadequate to handle the projected increase in volume of material between now and 2006 (CIWMB, 2001).

Two critical pieces of information are missing, however, in order to implement effective recycling policies for e-waste. First, there are no reliable estimates of the volume of e-waste stored households. Second, although there is an extensive general literature on recycling, there does not appear to be any study that focuses explicitly on recycling e-waste. The goal of this paper is to start addressing these two questions.

To that aim, we conducted a cross-sectional survey of consumer recycling behavior using a mail survey of randomly selected California residents, stratified by county. We randomly selected 6 California counties (3 in the North and 3 in the South, 2 urban and 1 rural counties in each case), and in each county we randomly selected 500 households, for a total sample size of 3000. Our survey comprised four main sections: (1) general environmental attitudes and behaviors; (2) specific information about e-waste awareness and quantity of obsolete electronics items stored in each household; (3) demographic and socioeconomic characteristics; and (4) five e-waste recycling options used for a contingent ranking exercise.

The survey was administered during the spring of 2004 and we obtained a response rate of approximately 12%, which is appropriate for this type of study and comparable to similar mail surveys. After an initial mailing, reminder cards were sent, followed by a new wave of questionnaires to the same addresses, and another reminder card.

In an extensive analysis, the characteristics of the respondents were then compared to the true characteristics of the California population using 2000 Census data. In general, our respondents tend to be older, better educated, and less ethnically diverse. They also have a higher household income and they are more likely to live in a detached home than expected in the counties surveyed. Overall, these results are not unexpected. Our survey was rather lengthy (12 pages) in order to collect socio-economic information, it was administered only in English because of limited funds, and it covered a topic that is more of interest to specific social groups (as suggested by the recycling literature).

Survey responses indicate that Californian households are currently stockpiling approximately 8.7 obsolete TVs (small and large), 8.0 million computers (desktop and laptops), 6.3 million monitors, and 38 millions of other large and small consumer electronic devices. These findings provide a more reliable estimate of the current volume of household e-waste and it confirms the inadequacy of the current recycling infrastructure in California.

Using contingency table analysis, we then analyzed relationships between key demographic/socioeconomic characteristics (as suggested by the existing literature) and environmental behavior/attitudes. We also performed principal components analysis (PCA) to combine some of the answers related to environmental attitudes to create 4 environmental indexes. They summarize people's attitudes in 4 different categories: (1) willingness to pay for various environmental issues; (2) environmental behaviors outside of the home such as

involvement with environmental organizations, attending meetings, signing petitions to support the environment; (3) environmental behaviors that occur primarily inside the home such as water conservation or using environmentally-friendly household products; and (4) beliefs regarding the state of the environment (in the U.S. and in California).

These environmental indexes were then used in an ordered probit model, along with other socio-economic variables, to explain the public's willingness to take e-waste items to drop-off locations for recycling, and more generally, to explain willingness to recycle electronic products. Our results indicate that the availability of curbside recycling, distance to drop-off recycling centers, and two of the environmental indexes are important predictors of the likelihood of recycling e-waste; by contrast, political affiliation, gender, age and education appear to be statistically non-significant. We are currently conducted extensive model specification tests (multicollinearity, nonlinearity, omitted variable bias, inclusion of irrelevant variables, residual analysis, and influential case analysis) to assess the robustness of our results.

In addition to informing public policy on what recycling options are preferred by the public in California, this paper contributes to the social-psychological literature on household hazardous waste recycling.