Sustainability **2014**, *6*, 2013-2030; doi:10.3390/su6042013

OPEN ACCESS

sustainability

ISSN 2071-1050

www.mdpi.com/journal/sustainability

Article

Sustainability as a Priority at Major U.S. Department of Energy's Defense Sites: Surrounding Population Views

Michael R. Greenberg [1,2,*], Marc D. Weiner [1,2], Henry Mayer [1,2], David Kosson [2,3] and Charles W. Powers [2,3]

[1] Edward J. Bloustein School of Planning and Public Policy, 33 Livingston Avenue, Rutgers University, New Brunswick, NJ 08901, USA;
E-Mails: mdw@ejb.rutgers.edu (M.D.W.); hmayer@ejb.rutgers.edu (H.M.)

[2] Consortium for Risk Evaluation with Stakeholder Participation, School of Engineering, Vanderbilt University, 299 Jacobs Hall, Nashville, TN 37235, USA;
E-Mails: david.kosson@vanderbilt.edu (D.K.); cwpowers@cresp.org (C.W.P.)

[3] School of Engineering, Vanderbilt University, 299 Jacobs Hall, Nashville, TN 37235, USA

* Author to whom correspondence should be addressed; E-Mail: mrg@rci.rutgers.edu; Tel.: +1-848-732-2383.

Received: 15 January 2014; in revised form: 26 March 2014 / Accepted: 28 March 2014 / Published: 10 April 2014

Abstract: Sustainability is rapidly becoming a widely accepted and desired attitude, as well as a stimulus for both environmentally-conscious individuals and firm behavior. However, does the public interest in sustainability also extend to large U.S. federal agencies? Does the public care about on-site sustainability programs? To answer this question, we surveyed 922 people who live within 50 miles of one of four U.S. Department of Energy's (DOE) major facilities: Hanford, Idaho National Laboratory, Savannah River and the Waste Isolation Pilot Plant. Only 14% expressed no interest in DOE's on-site sustainability efforts. Five percent said that they were interested enough to join a local community group to provide feedback to the DOE; 49% were interested and wanted more information, as well as interaction with the DOE's site-specific advisory boards or local elected officials. Compared to other DOE on-site activities, respondents rated sustainability as "somewhat important". Native Americans who live near a site, are familiar with it and self-identify as interested in environmental protection disproportionately belong to the "most interested" category. We conclude that public interest is sufficient to merit outreach by DOE to involve interested and knowledgeable local residents in on-site sustainability plans.

Keywords: U.S. Department of Energy; on-site sustainability; public interest

1. Introduction

In an introduction to a report celebrating the first Earth Day on 22 April 1970, Dunlap and Mertig [1] divided 20th century U.S. environmental history into three stages. The first focused on traditionally-considered conservation, best identified with John Muir, Theodore Roosevelt and Yosemite National Park [2–4]. The second stage began, more or less, in the mid-1930s, when the United States endured serious extensive and sustained flooding and environmental protection centered on reducing public risk from flooding. Many of these projects are historically identified with the U.S. Army Corps of Engineers and President Franklin Roosevelt [5,6].

The third phase of U.S. environmentalism began in the 1960s, and it is closely identified with the signing of the National Environmental Policy Act in 1970 and then legislation aimed at protecting water, air and land by controlling environmental toxins [7–11].

Twenty-five years after the American Association for the Advancement of Science (AAAS) symposium and approaching 45 years after the first Earth Day celebration, we are in the fourth U.S. environmental era, one centered on sustainability. This fourth era has many of the attributes of the third, especially the broad involvement of stakeholders and a broad range of issues, but adds a justice-across-generations component, which is a key philosophical element behind sustainability.

The public plays a critical role in this fourth stage. Public choices about what cars and appliances to buy, where to live, where to work and how to commute send messages to businesses and utilities about support for sustainability. Another message is stock purchases, and a third is the extent of support for candidates who support sustainability programs.

This paper explores a fourth signal that the public can send about its support for sustainability, through interaction with federal government sustainability efforts. At the local level, people can gather at municipal government and community meetings to discuss a wide range of sustainability-related choices, from how to manage trash collection and disposal, to what vehicles to purchase for the police and public works department, to how to redesign community buildings, and others.

Furthermore, there is no reason why members of the public could not also provide the same type of input about sustainability at the state and federal levels, as well. However, will they, or is sustainability on a nearby federal government site too physically and emotionally distant from residents to entice them to engage?

In order to answer this question, we had to overcome two obstacles. First, we needed a cooperating federal agency. The U.S. Department of Energy (DOE) was interested, and at our request, they suggested four sites where the results would be of particular importance, because they will be at these sites for many decades and will be making sustainability investments. The second obstacle was how to present sustainability to respondents. People understand the kinds of changes that they can initiate that are consistent with sustainability. Yet, it is not at all clear that the kinds of investments that a large federal agency will make on a large site will interest people who live in the region, but not nearby. For example, the DOE at one site has moved to replace a coal-fueled power plant with gas and solar sources. Residents can make an intellectual connection to such a project, but we did not expect that it would

sufficiently interest residents to cause them to engage. Hence, we chose a different connection to sustainability theory and the literature. In 2011, the Committee on Incorporating Sustainability in the U.S. Environmental Protection Agency [12] released the so-called "Green Book", which rests sustainability on three pillars. One of these is traditional environmental protection and resource minimization. The other two pillars, however, are economic and social sustainability, which we believe would be more likely to resonate with the local public. Specifically, economic sustainability implies working with local government on infrastructure and other projects that will benefit the DOE and the surrounding region, where the respondents live. Second, investing in on-site recreation in these predominantly rural regions we expected is a form of economic and social sustainability that would engage respondents.

In short, with a federal agency as a client and a theoretical base grounded in a broad definition of sustainability, we were satisfied that the project had a practical value and a theoretical grounding.

Given this context, we started with two assumptions. First, we assumed that there is some proportion of the public sufficiently interested in federal government sustainability efforts to at least want information about those programs. Second, we assumed that some proportion of those interested would be sufficiently interested to consider providing feedback about priorities to a federal department through a community committee, a web site or other mechanisms.

This paper reports on public reactions to on-site sustainability programs of the DOE at four key sites. To the best of our knowledge, this is the first effort to gauge the interest of local people in a federal sustainability program located in the publics' region, but not their backyard. More specifically, in mid-2013, we conducted a survey to ask three questions of those living near four major DOE environmental management sites:

(1) How important are DOE's sustainability programs compared to DOE's other ongoing activities, such as monitoring, surveillance, *etc.*? This is the sustainability priority question.
(2) How many are sufficiently interested to want information and might even attend meetings on the subject? How do they want to receive that information? This is the personal interest question.
(3) What are the attributes of those most interested in DOE's sustainability efforts? This is the respondent attributes question.

2. The DOE Environmental Management Context

Because the DOE is mandated to institute sustainability in its operations at the site levels, DOE sites are good choices for measuring public interest in federal government sustainability programs. In 2006, the DOE and 20 other federal agencies signed the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (MOU). The principles of the MOU were to optimize energy use, protect and conserve water, improve indoor air quality and improve design practices. Under Executive Order 13,514 issued in 2009, U.S. agencies, including the DOE, were required to reduce their carbon emissions, increase renewable energy use and meet energy and water reduction goals.

Since 2006, the Office of Management and Budget (OMB) has issued scorecards to evaluate agency sustainability performance. The colors, green, yellow and red, are used, respectively, to signify good, limited and poor progress. Altogether, the scorecard rates seven sustainability elements across these five

domains: water conservation, energy conservation, fleet petroleum use, reduction of greenhouse gas emissions and increases in green building practices and renewable energy use.

In January, 2013, the Office of Management and Budget [13] gave DOE green ratings on five of the seven metrics and red on two. The two red ones, signifying inadequate progress, were for: (a) insufficient reduction in fleet petroleum use; and (b) the lack of progress in green buildings practices. Looking across all the federal agencies, the DOE's performance was generally typical of federal departments and agencies.

The call for sustainability initiatives by federal agencies comes at a time when the DOE's budget is under pressure, as is the case for other major U.S. Government Departments. In 2009, as part of the American Reinvestment and Recovery Act (ARRA), the DOE budget was increased and investments were made in on-site projects, including those that would increase sustainability. However, ARRA has passed, site budgets are now tighter and the DOE must consider how to more effectively use its reduced resources.

DOE's investment in sustainability has two paths: the first is research aimed at developing technologies that improve sustainability; the second at making their own sites more sustainable. Several interest groups have objected to the first path. For example, Loris [14], writing for the Heritage Foundation, noted that DOE's budget had increased from $15.1 billion in fiscal year 2000 to $25.7 billion in fiscal year 2011 [14,15]. In addition to criticizing the magnitude of the increase, he singled out DOE's sustainability research for budget cuts, arguing that the U.S. private industry can develop green technologies.

In regard to the second path, site-specific sustainability, the DOE has mandated moral commitments to manage nuclear defense wastes [16]. It has on-site scientific and engineering research missions and now sustainability objectives. Ideally, as with any firm or agency, DOE can plan projects that incorporate sustainability into its programs. The question is which programs are higher priority and which are lower ones.

The DOE is one of those federal organizations that has an organizational culture inclined to listen to what local communities have to say. Formally, it has Site Specific Advisory Boards (SSAB) that work with the DOE staff to provide advice and recommendations on site-related topics. The SSABs reflect community views to the DOE and provide information to the community [17]. Exploring the public prioritization of sustainability and determining if there are residents sufficiently interested in the DOE's sustainability efforts to want more information and even to participate with DOE meetings would enhance DOE's interactions with its neighbors and facilitate stakeholder input. By supporting this study and suggesting key sites for the study, we believe that, depending upon the results, the DOE would engage their site advisory boards or another group to advise on their sustainability options.

3. Expectations

With the DOE context summarized, we consulted the literature and experts to form expectations for the 2013 survey that explored public interest and support for DOE's sustainability programs. This began with public opinion polls that have been measuring U.S. public understanding and support of sustainability practices for well over a decade. This literature reports broad support for sustainability. Usually, over two-thirds of survey respondents agree with the broad goals of sustainability and express

some personal interest in the subject [18–22]. Curiously, though, one polling house, Gallup [18], found strong support for sustainability, but showed no increase in respondents' sustainable behaviors and slightly less willingness, on the part of respondents, to prioritize environmental protection in 2010 than in 2000.

Furthermore, general interest is not the same thing as willingness to personally participate. Hence, a key question we tried to answer is how many people are willing to personally engage in working with DOE on its sustainability plans. The literature, albeit from about 15 years ago, suggests that few, less than 10%, would personally participate [23–26].

Given the variety of actions that are included under sustainability, Bodgan Vasi's [27] characterization of public support for sustainability as "a mile wide but shallow" and the United States Environmental Protection Agency (EPA) Green Book [12] helped shaped our thinking and design. Likely, there are differences in the extent to which the public prioritizes different aspects of sustainability. The risk perception and preference literature suggests a fairly economic approach, *i.e.*, that the public prioritizes those policies they perceive to directly benefit them [28–31].

In the context of the DOE objectives described earlier, protecting on-site resources for future regional residents would be a high priority, as would helping local and state government build a sustainable economy that would strengthen local organizations. In contrast, using less fuel on site and reducing on-site water and energy is not as obviously tied directly to local residents' personal benefits. Arguably, in fact, using less energy and water on site might be a loss for the local businesses that provide those utility services to the DOE. Hence, we would expect DOE's reducing energy and water use to be a lower sustainability priority than the other two.

Furthermore, with regard to the sustainability priority question (first research question), even among those who are very interested in sustainability, we had a strong expectation that there would be few local residents who prioritize sustainability ahead of DOE's other on-site activities, such as health and safety responsibilities to protect workers, sampling and protecting local air and water resources and providing and working with local off-site first responders required to act if there were a hazardous event that spread off the site.

Question 2 investigates the sources of information that residents prefer and their willingness to engage with the DOE. Here, while the literature shows that the public prefers notices in the mass media, such as television, newspapers and the radio [32–35], we have found that many prefer websites and community meetings. The DOE certainly has a wide capacity to provide information, including press releases through the media outlets, as well as directly, on a website or through school visits, community meetings and county fairs [17].

To generate categories of interest in the DOE sustainability categories, we consulted literature that considers preferences, perceptions, demographics and site location attributes. With regard to the first of the four categories, the most interested group, *i.e.*, those willing to work with DOE, previous studies suggest that those willing, for example, to participate on a committee are likely to have personal motivation, implying that they likely live near a site and are familiar with it. Consistent with the literature that speaks to those who will step into positions of power, we expect this group to disproportionately be male, be highly educated, affluent and older [36,37]. They also are likely to self-report interest in environmental protection generally and worry, more specifically, about the DOE site near which they live.

Race/ethnicity is an additional important attribute. At several of the western DOE sites, Native American populations are prominent. Native Americans have historically expressed strong beliefs about the DOE's future land use plans and use of resources [38,39]. As such, we expected to find a disproportionate number of Native Americans in this most interested group. In short, membership in this category, we expected, requires that the respondent be psychologically and physically connected to the site and want the role of a participant.

In strong contrast is the "least interested group". Those who express little interest in DOE's sustainability programs should have little at stake, little knowledge about the sites, little interest in environmental protection and not self-report worry about the site. In essence, the group should be disconnected physically and mentally from the site.

The third group includes some respondents who like the idea of sustainability, but only enough to ask for more information. This "lukewarm" group should share some attributes of the not interested group. For example, members should not be familiar with the site nor live in a host county. Perhaps they are young and not familiar with the entire area. However, still, some should be worried about the site, and as a whole, these respondents should support environmental protection.

The fourth group is interested, but they want the DOE to work with local advisory board members and local government, rather than to personally commit their time. This group is likely to exhibit strong environmental values, trust of the DOE and self-report worry about the site. Typically, we expect members of this category to be a model of affluent and highly educated whites who identify as political independents or Democrats and have moved to the Western U.S. during recent decades [40–42]. While many are likely to live near their local site, for them, sustainability represents a generic concept that they agree with, and they want to learn more about how the DOE intends to build a program.

Overall, we expected people to self-classify into one of these four groups. For us, the real issue is how many would fall into each of the four.

4. Data and Methods

4.1. Locations

The survey was focused on four sites at which the DOE expects to remain for many decades: Hanford (Washington), Idaho National Laboratory (INL) (Idaho), Savannah River (SRS) (South Carolina) and the Waste Isolation Pilot Plant (WIPP) (New Mexico). The 580 square mile Hanford site is located in southeastern Washington adjacent to the Columbia River in an area that hosts American Indian tribes, wineries and agricultural activities. The Hanford site substantially influences the regional economy, with research estimating that 16.5% of the regional economy directly emanates from the DOE waste management site [43]. When major areas of the United States were suffering from private market failures, Hanford's economy was less variable, due to anchoring by the DOE site's direct and indirect economic activity. The converse, however, is that when the DOE cuts its budgets, the Hanford region suffers badly [44].

The INL site is located in southeast Idaho about 30 miles from Idaho City in a semi-arid area that, because of its remote location, was chosen by the federal government for advanced military projects. These have included the testing of massive battleship guns and the development of new nuclear reactor designs [43]. There is a major waste management program on the site. The 890 square mile site is a

critical location for research and development, as well as waste management. Like Hanford and the other sites in this study, the regional economy heavily depends on the DOE site.

Savannah River is a 310 square mile facility with an ecological preserve, several DOE science missions and the world's largest facility that processes high-level defense waste by mixing it with molten glass and pouring the mixture into storable stainless steel canisters [43]. Among DOE's major sites, none offers more markedly different images than Savannah River. About 10% of the site has massive waste management and nuclear facilities, and these are relatively close to some of the most beautiful stands of forest that have remained untouched for over 60 years [45].

The WIPP site manages transuranic nuclear waste, which is created during weapon manufacturing and includes nuclear elements, such as americium, neptunium and plutonium, with atomic numbers higher than uranium [46]. Opened in 1999, the 16 square mile WIPP site is not only a key asset, but is the rare exception, where a facility that most would consider as a locally unwanted land use (LULU) was successfully sited, at least partly, because the DOE worked with local officials to reach an agreement [47].

Overall, each of these four sites will operate for many decades and, as such, constitute logical locations for DOE investment in major sustainability programs. Indeed, in order to enhance working relationships with local officials, planners and environmental managers and their public, it makes sense for the DOE to understand the plans of these communities and work with these communities on sustainability.

4.2. Survey Design and Administration

The survey design used a dual-frame cell and landline sample frame to collect a random sample of 230 completed interviews per site, for a total of 920. The margin of standard error, at 95% confidence at 50/50 proportions, is +/− 3.2%. This means that if half of the respondents report that they "strongly support" a new DOE sustainability program, we can be 95% confident that the actual, "true" population proportion is between 46.8% and 53.2%. The margin of sampling error by site is 6.4%; in other words, the 95% confidence limits for the example above would be between 43.6% and 56.4%.

The dual frame design used 75% land line and 25% cell phone numbers. Currently, about 40% of the United States population use only cell phones for calls, a remarkable change during the last decade that continues. When we add those who have a landline, but "mostly use" their cell phone (about 15%), we see that 55% of the population cannot be reached by a traditional household-based landline telephone [48]. Indeed, unless there are extraordinary extenuating circumstances, all telephone population surveys should have an appropriately proportional cell component to avoid age bias. For this survey, eligible respondents were 18+ years old, non-institutionalized and lived near one of the four US Department of Energy, Environmental Management (DOE-EM) sites.

We took four steps to directly tie the 2013 survey to previous ones [43]. The first was to define eligible respondents as living within 50 miles of one of the four DOE sites. Fifty miles is a compromise between a 100-mile sample area that would over-represent those who know and care little about the site and a 20-mile area that would over-represent the interests of those who work or otherwise directly benefit from the site. Second, as in prior surveys, we used post-stratification weighting to adjust for any potential bias in age and race/ethnicity. Third, as with prior surveys, the survey was field-administered from late June through the end of August to avoid seasonal-related differences in the results. Fourth, the survey, developed by the authors, was administered over the phone by the Bloustein School Center for

Survey Research under the American Association for Public Opinion Research standards. Generally speaking, this means that all due efforts were taken to minimize bias and error due to the house effects of the organization administering the survey.

4.3. Questions

Beginning in 2005, the authors have asked residents about the importance they attach to DOE environmental management practices at major sites. Many of the same questions were asked in 2010 and 2013, including those about regularly monitoring the health of site workers, sampling air and water quality, shrinking the area on site that is contaminated, providing resources to local first responders, requiring DOE to report information to community representatives and others listed in Table 1 and reported elsewhere, including the monitoring of soil, fauna and flora. All of these questions have been pilot tested and used in multiple surveys [43]. They served as standards to compare to sustainability questions added to the survey.

For this study of sustainability, we added three new questions about sustainability to the mix of questions in the 2013 survey in order to determine the relative importance respondents attached to these three compared to the others. The first probes the importance of protecting on-site forests, soils and animals. The second examined the importance of the DOE working with local officials on economic development in the area by improving transportation and securing jobs. The third spoke to resource use sustainability, by asking about reducing the site's use of energy and water and the site's transportation fuel use. All the questions were scored on a 1 to 10 scale, where 1 represents low priority and 10 represents very high priority.

A key question was a direct revealed preference probe as to how interested respondents are in DOE's sustainability programs. Four choices were provided, and respondents were prompted to select the one which best describes them: (1) interested and might volunteer to be on a community committee; (2) interested, but want the DOE to work with a local advisory committee and local elected officials; (3) like the idea, but need more information; and (4) not interested in the effort.

With regard to alternatives for receiving information, the usual options were provided: television, newspaper, radio, community meetings, DOE website and local community fairs. A final category, called "other", was used to obtain respondent ideas.

Another question was added to obtain information about public attitudes and preferences about waste management protocols, a key nuclear policy issue of which many of these respondents, in light of the 2011 disaster at Fukushima Daiichi, should be aware. Since the nuclear disaster at Fukushima in 2011, which included explosions and fires involving fuel pools, the DOE and U.S. Nuclear Regulatory Commission have been studying options for managing used nuclear fuel in the U.S. The current U.S. policy allows the utilities to keep the fuel in storage pools; about 70% of the used commercial nuclear fuel is currently stored in pools, and the remaining 30% is in casks. A policy change that would reduce risk is to remove on-site autonomy about dealing with waste and requiring the used fuel to be put in casks as soon as practically possible. We assumed that those who strongly identify with environmental protection would choose this policy.

Questions probed preferences and values, site-related perceptions and demographic attributes. The preference questions asked about respondent interest in receiving information. Respondents could ask

for up to seven information sources. Next, to gauge their interest in environmental issues, we asked their level of support for general environmental issues. The choices were: (1) active supporter; (2) supporter, but not active; (3) neutral; and (4) not concerned about environmental problems. Furthermore, as part of the preferences and values, we asked respondents to self-identify as Republican, Democrat, Independent, and an "other" option was provided.

With regard to site-related perceptions, we determined if the respondent lived in a host county (*i.e.*, the county in which the site sits) and then asked about familiarity with the site and how worried a respondent was about the site, on a scale of 1 to 10 (10 being most worried).

A set of six questions asked about the trust of DOE and site contractors. Two of those probed competence-related trust. The first of these asked if the DOE would make sure the underground radioactive and chemical materials would not leave the site and pollute the air, land and water outside the site. The second asked if the DOE can effectively manage any new nuclear-related activities. The third explored value-related trust by asking if the respondent believes that the DOE communicates honestly with the people in the area. Each asked for agreement, and the options ranged from "strongly agree" to "strongly disagree". The same three questions were asked about site contractors.

These trust questions are important, because perceptions of trust can play out in several parts of this work. First, distrust is likely negatively associated with the willingness to engage with the DOE. Second, as pointed out by one of the external reviewers, distrust could impact a respondent's assessment of the credibility of the DOE's existing programs, for example, unwillingness to trust monitoring and surveillance data collected by the DOE or a contractor to the DOE.

The third group of questions probed for demographics attributes: race/ethnicity, sex, income, age and education.

4.4. Methods of Analysis

The answers to the first two research questions were obtained by comparing averages and proportions. Key comparisons were checked with *t*-tests of differences-of-means. Answering the third question required a more complex statistical analysis. The variable degree of interest in DOE's sustainability programs had four outcomes. Multinomial regression is the most efficient method for comparing each of the three interested groups to the not interested one. The use of multinomial regression meant that the form of several variables had to be modified. Multinomial regression fits each value of the predictors to a categorically-dependent variable, in this case with four categories. When the predictor has a large number of responses, continuous predictor variables can produce useful results. However, when the interaction is based on 2–6 cases, which was the case in some of these analyses, the match is meaningless, because of the small sample size. Hence, to produce meaningful categories for the "worried about the site" variable (range, 1–10) and the aggregate trust variable (range, 1–30), we created four categorical variables: "very worried" (range 8–10) and "not worried" (range, 1–3) and "low trust" (range, 1–10) and "high trust" (range, 16–30). Prior to creating the trust scale, the six measures of trust were tested as a single scale with Cronbach's alpha. Traditionally, a Cronbach's alpha of ≥ 7 is adequate to sustain the validity and usefulness of a scale. In this case, the Cronbach's alpha was 0.87.

5. Results

The survey was pilot-tested on 24 June 2013. The data were collected during the period of 26 June 2013 to 30 August 2013. A total of 922 responses were collected: 231 each at INL and Hanford and 230 each at SRS and WIPP. The response rate was 26.1% for the full sample, and the cooperation rate was 44.3%. Public surveys do not perfectly mirror resident demographic characteristics. We compared the demographics of the people who live in each region using recent United States government data with the sample responses. In order to make the samples as representative as possible, we weighted the sample data files by white-nonwhite and age group ratios for each site-region. This reduces bias in the data. However, it is never possible to completely correct differences between the sample and actual populations, because all of the factors that influence the results are not accounted for in the weights.

5.1. Question 1. How Important Is Sustainability?

The 2013 results are consistent with prior years. Public health actions, such as monitoring worker health and sampling the air and water, were the most preferred actions, while organizational options the least preferred. Table 1 summarizes the results for 2010 and 2013.

Comparatively, the three sustainability metrics ranked sixth, tenth and thirteenth of 13. In other words, these data show that sustainability, defined by these three questions, is somewhat important to respondents. Protecting on-site forests, soils and animals was the highest scored of the three and fell immediately below public health monitoring and surveillance and reporting to community representatives.

Table 1. Public preferences for sustainability and other activities at Hanford, Idaho National Laboratory, Savannah River and the Waste Isolation Pilot Plant, 2010 and 2013.

Management options [##]	**Average value** [#]**, 2013 (standard deviation) (n = 922)**	**Average value** [#]**, 2010 (standard deviation) (n = 1400)**
PH-2: regularly monitor health of site workers	8.90 (1.99)	8.74 (2.04)
PH-1: continuously sample the quality of the air and water at the site	8.72 (2.31)	8.84 (2.05)
PH-3: provide specialized training and equipment to emergency response personnel from surrounding areas	8.60 (2.19)	8.58 (2.23)
PH-4: install an early warning system to alert residents to any problems	8.42 (2.54)	8.23 (2.64)
ORG-1: require that the government report information about the site to community representatives on a regularly scheduled basis	8.35 (2.29)	8.15 (2.40)
SUS-1: protect on-site forests, soils, and animals*	8.28 (2.49)	NA
SR-6: shrink the area that is contaminated to as small a size that it is feasible	8.21 (2.69)	7.99 (2.62)
SR-1: make sure that the federal government owns the site until all hazards are removed	8.19 (2.65)	8.38 (2.55)
PH-6: regularly monitor the health of the people who live near the sites	8.10 (2.62)	7.81 (2.65)
SUS-2: advance regional economic development **	7.99 (2.51)	NA
ORG-3: maintain the role of Citizen Advisory Boards that currently represent the community interests at the site	7.60 (2.45)	7.79 (2.42)

Table 1. *Cont.*

Management options ##	Average value, 2013 (standard deviation) (n = 922)	Average value, 2010 (standard deviation) (n = 1400)
SR-4: do not allow any new nuclear-related activity on the site	6.28 (3.54)	NA
SUS-3: reduce site use of energy and water, and use of transportation fuel ***	6.03 (2.91)	NA

* SUS-1 was significantly lower than PH-2, PH-1, PH-3 and PH-4 and significantly higher than PH-6, SUS-2, ORG-3, SR-4 and SUS-3 at $p < 0.05$ with the difference of means *t*-test; ** SUS-2 was significantly lower than PH-2, PH-1, PH-3, PH-4, ORG-1, SUS-1, SR-6 and SR-1 and significantly higher than ORG-3, SR-4 and SUS-3 at $p < 0.05$ with the difference of means *t*-test; *** SUS-3 was significantly lower than all others at $p < 0.05$ with the difference of means *t*-test; # The numbers in the table are averages and the range is from 1 (low priority activity) to 10 (highest priority activity); ## The management options are divided into public health (PH), organizational (ORG), site restriction (SR) and sustainability (SUS).

5.2. Desire for More Information about Sustainability

Table 2 shows public interest in DOE's sustainability programs. About 5% at each site said that they would consider volunteering to serve on a committee, and almost half said that they are interested, but want the DOE to work with their site advisory board and local elected officials. About one-third was interested, but needed more information, and only 14% expressed no interest. The order of group preferences did not vary by site.

Table 2. The desire for more information about the Department of Energy's (DOE) sustainability programs by DOE site #.

Options	All sites * (n = 913)	Hanford (n = 228)	INL (n = 230)	Savannah River (n = 226)	WIPP (n = 229)
Am interested and might volunteer to be on a community committee	4.9	4.8	4.3	5.3	5.2
Am interested, but would like DOE to work with local site advisory committee and local elected officials	49.1	57.0	43.5	46.0	49.8
Like the idea, but need more information	32.0	25.4	36.5	36.7	29.3
Not interested in the effort	14.0	12.7	15.7	11.9	15.7
Total	100.0	99.9	100.0	99.9	100.0

* Four sites are not statistically significant from each other; ANOVA with post-hoc Tukey B test of means at $p < 0.05$; # Numbers in the table are percentages.

The vast majority were interested in more information, so we asked them to pick the medium for delivery. Seven options were provided (Table 3) for a total of 3020 responses, or about 3.3 per survey respondent. The mass media (local television and the local newspaper) were both selected by over 18%, followed by local radio with 15%. That means that almost half of the selections were not for mass media. At the top of the non-mass media options were a DOE website (15%), community meetings (16%) and

local community fairs (12%). Those suggested as part of the "other" category included the social media, pamphlets, newsletters, library programs and notices and, even, by one "enthusiastic" respondent, skywriting. What is interesting is that the median respondent identified three sources, the average was 3.3, and, yet, the mode was to pick six options for providing information. As discussed further below, this suggests that there is a distinct group with great interest in receiving information from multiple sources (see the Discussion section).

Table 3. Respondent interest in obtaining information from multiple sources.

Source	% selecting source
Local television	18.8
Local newspaper	18.3
Community meetings	16.3
Local radio	15.1
DOE website	15.1
Local community fairs	12.0
Other	4.4
Total	100.0

5.3. What Are the Attributes of Those Interested in and Willing to Participate in the DOE Sustainability Program?

In Section 3, we suggested profiles of people that were interested in and would be willing to engage in the DOE's sustainability programs. Beginning with the simple binary of interested *versus* not interested, Table 4 shows that many, although not all, of the expectations were met. The results of the multinomial regressions compare each of the three interested groups to the base outcome, the 14% "not interested" in the program. Those who were interested in DOE's sustainability programs self-identified as environmental supporters and as political independents; they trusted the DOE, but worried about the site and tended to be college educated. In contrast, those who were not interested in DOE's sustainability programs did not strongly support environmental protection programs, did not identify as political independents, did not trust the DOE, nor, however, did they worry about their local site; disproportionately, they were not college educated.

The most meaningful differences among the three interested groups, however, are more subtle. The "interested enough to potentially join a committee" group (5%) was well-defined by location and demographic attributes. They were more likely to be male, college educated, relatively affluent, political independent, self-report being "very familiar" with the site and be living in a host county. The most interesting distinction was that disproportionately, they were Native Americans. Indeed, 20% of Native American respondents said they would consider serving on a DOE committee compared to only 4.2% of other respondents.

The largest group (49%) indicated interest, but wanted the DOE to work with advisory committees or local officials. Compared to the other groups, this one's members were disproportionately female, older, worried about the local DOE site, but trusted the DOE. Their preferences were to have nuclear fuel placed in casks as soon as practically achievable, and not surprisingly, they self-identified as environmental supporters and Democrat or Independent. They fit the profile of environmental supporters.

Table 4. Attributes of willingness to participate in DOE sustainability programs [#].

Predictor variables [##]	**Interested and might be willing to serve on committee**	**Interested and want DOE to work with local committees**	**Like the idea, need more information**	**Chi-square**
Constant	1.48	3.98	3.35	
Preferences and values				
Want used commercial nuclear fuel moved to casks as soon as practically achievable (1 = yes)	−0.49	0.42 ***	0.18	9.7 ***
Self-identify as strong environmental supporter (1 = yes)	0.72 **	0.74 ***	0.46 *	7.5 **
Self-identify as Democrat	− 0.71	0.49 *	0.13	6.1 *
Self-identify as Independent	0.31	0.55 **	0.59 *	3.4
Self-identify as Republican	−0.24	0.22	0.09	1.1
Site-related perceptions				
Low trust (trust scale <11 of 30)	−0.25	−0.12	0.39	1.7
High trust (trust scale 16+ of 30)	0.36	0.65 ***	0.57	4.4 *
Very worried about site (8–10 of 10)	0.36	0.98 ***	0.89 ***	7.1 **
Not very worried about site (1–3 of 10)	−0.81 **	−0.11	0.02	4.8 *
Self-identified as very familiar with site (1 = yes)	0.60 *	−0.13	−0.28	5.0 *
Resident of host county	0.44	0.35 *	−0.28	12.2 ***
Demographic attributes				
Self-identify as White	−0.59	0.06	0.09	1.8
Self-identify at Native American	1.55 ***	−0.14	−0.32	8.0 ***
Male respondent	0.41	−0.24	−0.02	5.0 *
Family income <$50,000 a year	−0.01	−0.14	0.48 *	10.2 ***
Family income >$75,000 a year	0.67 *	0.04	0.21	2.5
Age 18–54 years	0.01	−0.47 ***	0.75 ***	12.6 ***
4-year college education	0.58 *	0.14	0.31	2.5
Nagelkerke-pseudo-r2 of aggregate				0.145***

[#] The comparison group for this analysis is the 14% that are not interested in the program, and the numbers in columns 2-4 are B-values from the multinomial regression; [##] All variables in the table are dichotomous (1 or 0); *** Statistically significant at $p < 0.05$, **at $p < 0.10$,* at $p < 0.20$.

The second largest group (32%) reported liking the idea, but, having the option, selected wanting more information. This group is differentiated from the others primarily on site-related issues. They self-identified as Democrat, were disproportionately poor and younger. Their trust of DOE ranged, and they are the group least worried about the site. This may be because they were least likely to be a resident of a host county and were least familiar with the site.

6. Conclusions

Measured against public health surveillance programs, DOE's sustainability efforts to protect site forests, soils and animals and advancing regional economic development are lesser priorities; DOE's effort at reducing energy and water use and reducing transportation fuel use are low priorities. Yet, with mean scores of 8.3, 8.0 and 6.0 on a 10-point scale, these forms of sustainability resonated with residents living proximate to a DOE site. Sustainability in the DOE is important to them.

This finding is supported by the observation that 86% of respondents were interested in DOE's sustainability programs. Perhaps the most important were the 5% who were sufficiently interested to self-report interest in potentially volunteering to serve on a community committee to work with the DOE. They lived near the site, were familiar with it, were disproportionately college educated and affluent and disproportionately self-identified as Native American. This group of 5% of the total sample population could provide key and otherwise unavailable insights to the DOE, in addition to its advisory board and local elected officials.

Finally, with regard to providing information, the overwhelming majority self-reported wanting information about DOE's sustainability programs. However, some picked all seven information source categories. Notably, 9% of respondents in the group that said that they would consider working with the DOE chose all seven information source options. This is best understood when compared to the 2% (who selected all seven information source options) in the other two groups that expressed any interest in the DOE sustainability program. Some of their suggestions included DOE providing them with resources to develop and operate a sustainability website, helping DOE build a booth that could be taken to public meetings, creating electronic bulletins, and others.

The major limitation of this survey was the limited number of questions, especially about sustainability options. A useful follow-up would be to conduct focus groups with some citizens who correspond to the "more interested" category. Some appropriately designed qualitative research would be helpful to explore the thought processes and the identification of interests that drive this level of willingness to participate. Specifically, Native Americans should be qualitatively analyzed separately, as well as incorporated into larger qualitative descriptions and inferences. A mixed-mode approach, *i.e.*, qualitative research complementary to this and related quantitative research, can yield valuable information with regard to public response and reaction to and the propensity to participate with the DOE's sustainability programs.

In the introduction, we adopted EPA's three pillars of environment, economic and social sustainability [12] from the Green Book as the theoretical base for the study. We did this not because we disagree with other definitions in the literature, but rather because the practical implications, we believed, would be more willingness to engage. Indeed, the survey showed that respondents did distinguish between these three pillars. They were most interested in protecting forests, soils and animals. This ranked sixth out of 13 priorities. Helping to bolster the regional economy ranked 10th, and reducing on-site use of water and energy use ranked last, or 13th. This order was consistent with our expectations, and it is notable that protecting forests, soils and animals ranked higher than did shrinking the size of the contaminated area, making sure that the federal government owns the site until all hazards are removed, regularly monitoring the health of nearby residents and several other activities.

As a follow-up, large-sample surveys represent an opportunity to learn more about the connections people make between their own efforts to implement sustainability at home and the workplace, in support of local government efforts, in support of state government and agencies and of those efforts of large federal external agencies, like the DOE. We speculate that public reaction to the DOE would be different than to the Departments of Agriculture, Interior and Defense, for example, which play different roles than the DOE does in these four regions. Such surveys would be an opportunity to developed nuanced and potentially valuable theoretical insights about how different large land-holding federal agencies are perceived by their local populations in regard to sustainability.

With these study results as a base, it is realistic to believe that federal departments/agencies with landholdings can connect to some members of their neighboring jurisdictions in order to test their sustainability ideas and investments, to hear some from the communities and to use this connection to broaden the base of individuals willing to interact with these federal departments about sustainability and other issues. Additional research should explore the role of for- and not-for-profit non-governmental agencies.

In the short run, the DOE will be at these four sites for many decades. By sponsoring this study and now considering the results, it has the chance to broaden its base of local people that consider it an honorable neighbor, that want to work with it on various topics. Sustainability represents another way of building a sustainable, long-term cooperative link between the DOE and its neighbors.

Acknowledgements

This research was prepared with the support of the U.S. Department of Energy, under Cooperative Agreement Number DE-FC01-06EW07053. We appreciate the thoughtful suggestions of two reviewers. The authors thank the Consortium for Risk Evaluation for the Stakeholder Participation III awarded to Vanderbilt University. The opinions, findings, conclusions or recommendations expressed herein are those of the authors and do not necessarily represent the views of the Department of Energy or Vanderbilt University or any of the people acknowledged. This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed or represents that its use would not infringe privately owned rights.

Author Contributions

Michael Greenberg designed the study, developed the first draft of the questions, analyzed the results and wrote the first and final drafts. Marc Weiner critiqued the draft questions, was responsible for administering the survey, reviewed the results and critiqued the first draft. David Kosson and Charles Powers suggested the project, discussed key elements of the survey and reviewed the questions and the first draft. Henry Mayer reviewed the draft questions, which led to several major changes, discussed the design and reviewed the first draft.

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Dunlap, R.; Mertig, A. The evolution of the U.S. Environmental Movement from 1970 to 1990. *Soc. Nat. Resour*. **1991**, *4*, 209–218.
2. Brinkley, D. *The Wilderness Warrior*; HarperCollins: New York, NY, USA, 2009.
3. Fox, S. *John Muir and His Legacy: The American Conservation Movement*; Little Brown: Boston, MA, USA, 1981.
4. Morris, E. *Theodore Rex*; Random House: New York, NY, USA, 2001.
5. U.S. Army Corps of Engineers. *The U.S. Army Corps of Engineers: A History*; U.S. Army Corps of Engineers: Alexandria, VA, USA, 2000.
6. Stucker, M. The *Good Neighbor: Franklin D. Roosevelt and the Rhetoric of American Power*; Michigan State University Press: East Lansing, MI, USA, 2013.
7. Brown, M. *Laying Waste*; Washington Square Press: New York, NY, USA, 1979.
8. Carson, R. *Silent Spring*; Fawcett Press: Greenwich, CT, USA, 1962.
9. Fallows, J. *The water Lords*; Bantam Books: New York, NY, USA, 1971.
10. Zwick, D.; Benstock, M. *Water Wasteland*; Bantam Book: New York, NY, USA, 1971.
11. Oates, D. *Earth Rising: Ecological Beliefs in an Age of Science*; Oregon State University: Corvallis, OR, USA, 1989.
12. Committee on Incorporating Sustainability in the U.S. Environmental Protection Agency, National Research Council. *Sustainability and the U.S. EPA*; National Academy Press: Washington, DC, USA, 2011.
13. OMB Sustainability and Energy Scorecards. Available online: www.whitehouse.gov/administration/eop/ceq/sustainability/omb-scorecards (accessed on 15 July 2013).
14. Loris, N. Department of Energy budget cuts: Time to end the hidden green stimulus. Available online: http://www.insideronline.org/summary.cfm?id=17173 (accessed on 5 January 2013).
15. Department of Energy FY 2014 Congressional Budget Request. Available online: http://energy.gov/sites/prod/files/2013/04/f0/Volume5.pdf (accessed on 2 January 2014).
16. U.S. Department of Energy—Office of Environmental Management. Closing the Circle on Splitting the Atom. Available online: http://energy.gov/sites/prod/files/2014/03/f8/Closing_the_Circle_Report.pdf (accessed on 3 January 2014).
17. Greenberg, M.; Lowrie, K.; Hollander, J.; Burger, J.; Powers, C.; Gochfeld, M. Citizen board issues and local newspaper coverage of risk, remediation and environmental management: Six United States nuclear weapons facilities. *Remediation* **2008**, *18*, 79–90.
18. Morales, L. Green behaviors common in U.S., but not increasing. Available online: www.gallup.com/poll/127292/Green-Behaviors-Common-Not-increasing.aspx (accessed on 3 January 2014).
19. Capstrat. Available online: https://www.capstrat.com/posts/poll-shows-commitment-to-/ (accessed on 3 January 2014).

20. Cohen, S. Measuring public opinion on environment and sustainability: How conventional wisdom gets that way. Available online: http://observer.com/2009/08/measuring-public-opinion-on-environment-and-sustainability-how-conventional-wisdom-gets-that-way/ (accessed on 3 January 2014).
21. Leiserowitz, A.; Kates, R.; Parris, T. Do global attitudes and behaviors support sustainable development? *Environment* **2005**, *47*, 22–28.
22. Smart Growth America. Building for the 21st century: American support for sustainable communities. Available online: www.smartgrowthamerica.org/documents/building-for-the-21st-century.pdf. (accessed on 3 January 2014).
23. Goldstein, B.; Erdal, S.; Burger, J.; Faustman, E.; Friedlander, B.; Greenberg, M.; Leschine, T.; Powers, C.; Waishwell, L.; Williams, B. Stakeholder participation: Experience for the CRESP program. *Environ. Epidemiol. Toxicol.* **2000**, *2*, 103–111.
24. Beierle, T.; Cayford, J. *Democracy in Practice: Public Participation in Environmental Decisions*; RFF Press: Washington, DC, USA, 2002.
25. King, C.; Feltey, K.; Susel, B. The question of participation: Toward authentic public participation in public administration. *Public Adm. Revi.* **1998**, *58*, 317–326.
26. Chess, C.; Purcell, K. Public participation and the environment: Do we know what works? *Environ. Sci. Technol.* **1999**, *33*, 2685–2692.
27. Bogdan Vasi, I. Public support for sustainable development: A mile wide, but how deep? *Consilience: J. Sustain. Dev.* **2012**, *98*, 153–170.
28. Baldassare, M.; Katz, C. The personal threat of environmental problems a predictor of environmental practices. *Environ. Behav.* **1992**, *24*, 602–616.
29. De Young, R. New ways to promote proenvironmental behavior: Expanding and evaluating motives for environmentally responsible behavior. *J. Soc. Issues* **2000**, *56*, 509–526.
30. Padel, S.; Foster, C. Explaining the gap between attitudes and behavior, understanding why consumers buy or do not buy organic food. *Br. Food J.* **2005**, *107*, 606–625.
31. Black, J.; Stern, P.; Elworth, J. Personal and contextual influences on household energy adaptation. *J. Appl. Psycho.* **1985**, *70*, 3–21.
32. Fenton, N. *News Media, Old News: Journalism and Democracy in the Digital Age*; Sage: London, UK, 2010.
33. Gallup, A.; Davenport, F. *The Gallup Poll: Public Opinion 2004*; Rowman and Littlefield: Lanham, MD, USA, 2006.
34. Page, B.; Shapiro, R.; Dempsey, G. What moves public opinion*? Am. Politi. Sci. Rev.* **1987**, *81*, 23–44.
35. Robinson, J.; Levy, M. News media use and the informed public: A 1990s update. *J. Commun.* **1996**, *46*, 129–135.
36. Flynn, J.; Slovic, P.; Mertz, C.K. Gender, race and the perception of environmental health risks. *Risk Anal.* **1994**, *14*, 1101–1118.
37. Finucane, M.; Slovic, P.; Mertz, C.K.; Satterfield, T. Gender, race, and perceived risk: The white male effect. *Health Risk Soc.* **2000**, *2*, 159–172.
38. Callicott, J. Traditional American Indian and Western European attitudes toward nature. *Environ. Eth.* **2008**, *4*, 293–318.

39. Lewis, D. Native Americans and the environment: A survey of twentieth century issues. *Am. Indian Q.* **1995**, *19*, 423–450.
40. Florida, R. *The Rise of the Creative Class*; Basic Books: New York, NY, USA, 2002.
41. Florida, R. The rise of the creative class. Avaliable online: www.washingtonmonthly.com/features/2001/0205.florida.html (accessed on 18 October 2013).
42. Riebsame, W.; Gosnell, H. *Atlas of the New West: Portrait of a Changing Region*; W.W. Norton and Company: New York, NY, USA, 1997.
43. Greenberg, M. *Nuclear Waste Management, Nuclear Power and Energy Choices: Public Preferences, Perceptions, and Trust*; Springer Publishers: New York, NY, USA, 2012.
44. Greenberg, M.; Isserman, A.; Frisch, M.; Krueckeberg, D.; Lowrie, K.; Mayer, H.; Simon, D.; Sorenson, D. Questioning conventional wisdom: The regional economic impacts of major U.S. nuclear weapons sites, 1970–1994. *Socio-Econ. Plan. Sci.* **1999**, *33*, 183–204.
45. Greenberg, M.; Lowrie, K.; Krueckeberg, D.; Mayer, H.; Simon, D. Bombs and butterflies: A case study of the challenges of post cold-war environmental planning and management for the United States nuclear weapons sites. *J. Environ. Plan. Manag.* **1997**, *40*, 739–750.
46. Greenberg, M.; West, B.; Lowrie, K.; Mayer, H. *The Reporters Handbook on Nuclear Materials, Energy, and Waste Management*; Vanderbilt University Press: Nashville, TN, USA, 2009.
47. Jenkins-Smith, H.; Silva, C.; Nowlin, M.; de Lozier, G. Reversing nuclear opposition: Evolving public acceptance of a permanent nuclear waste disposal facility. *Risk Anal.* **2011**, *31*, 629–644.
48. Blumberg, S.J.; Luke, J.V. National Health Interview Survey. Available online: http://www.cdc.gov/nchs/nhis.htm (accessed on 18 October 2013.)