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Assessing the Potential of Social Networks as a Means for Information Diffusion – the Weatherization Experiences (WE) Project

Erin Rose
Beth Hawkins
Brian Conlon
Inga Treitler

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OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

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Environmental Sciences Division

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Erin Rose, Oak Ridge National Laboratory
Beth Hawkins, Oak Ridge National Laboratory
Brian Conlon, University of Tennessee, Knoxville
Inga Treitler, Anthropology Imagination, Inc.

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Prepared by
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ACRONYMS

ARRA	American Recovery and Reinvestment Act of 2009
CAA	Community Action Agencies
DIY	Do It Yourself
DOE	U.S. Department of Energy
EDA	Exploratory Data Analysis
GHG	Greenhouse Gas
HHS	U.S. Department of Health and Human Services
IEQ	Indoor Environmental Quality
LIHEAP	Low Income Home Energy Assistance Program
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory
OWIP	Office of Weatherization and Intergovernmental Programs
PI	Principal Investigator
PY	Program Year
SES	Socio-economic status
SNA	Social Network Analysis
SPSS	Statistical Package for the Social Sciences
WAP	Weatherization Assistance Program
WE	Weatherization Experiences

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EXECUTIVE SUMMARY

In April 2009, U.S. Department of Energy (DOE) formally tasked Oak Ridge National Laboratory (ORNL) with conducting two impact and process evaluations of DOE's Weatherization Assistance Program (WAP), known as the retrospective and American Recovery and Reinvestment Act of 2009 (ARRA) period evaluations, respectively. The former focused on WAP Program Year (PY) 2008, which covers the period from April 2008 to June 2009. The latter focused on PY 2010. This report presents in-depth analyses from ORNL's social network study, the Weatherization Experiences (WE) Project, an exploratory study conducted as part of the ARRA period WAP evaluation.

The WE Project explored the potential for WAP recipients and staff to influence energy savings *beyond* their homes and day jobs. Several studies conducted through ORNL's evaluation of WAP found that the program has the ability to profoundly impact the lives of the people it serves (Tonn et al. 2014b). Recipients of WAP provided statements ranging from the newfound ability to pay utility bills and prescription medication to reduced emergency department visits for asthma and medical conditions associated with thermal stress. Through this exploratory research project, the stories of hundreds of weatherization recipients and providers were documented. The WE Project was designed to further investigate whether or not shared experiences with weatherization have the power to stimulate home energy saving action within an individual's social network.

Individuals belong to complex webs of social networks[1] comprised of multiple types of relationships, interactions and functions. The goal of this special study was to explore linkages between individuals within these multi-level and multi-relational social systems starting with the initial communication by the WAP agency, staff, or recipient. In this report we refer to these potential catalysts for spurring home energy-efficiency as "nodes." This reading of the community helps understand if and what type of weatherization information is being shared (i.e., energy cost savings, health benefits), what core values are in place that might support or hinder adoption of new energy usage behaviors, and the motivating factors contributing to action taken after information is received from a known, or trusted source. The WE Project sought to identify topics most communicated and to measure the impacts of these shared weatherization experiences on the actions of others. The primary goal of this study was to capture any energy and non-energy impacts resulting from shared communication as additional benefits attributable to WAP.

To conduct the WE Project, weatherization staff and recipients of the program were recruited by 10 local agencies that had been purposively selected for the WAP national evaluation's case study report[2]. Those recruited were then asked to conduct interviews with members of their social network that they had communicated weatherization information to. This technique, known as participatory research, allowed for information to be collected starting with the initial recipient or staff as a node of communication. These individuals were trained by the evaluation team to administer semi-structured questionnaires (Appendix C) to their friends and family to unearth whether or not their own experience with weatherization incited actions to increase home energy efficiency, and to capture the motivations for those actions. The interviews sought to answer five overarching questions through the efforts of the researchers: *Who did you tell? What did you say? What did they hear? What did they do? and Why?* The interviewers then asked the members of their social network if they had discussed weatherization with anyone within *their* social network. This snowball sampling method allowed for an assessment of the diffusion of information into the second degree of separation from the initial node (household recipient or

[1] "Social networks" is defined in this report as a self-identified set of dyadic (group of two) social relationships and/or interactions (i.e., kinship, friends, and neighbors).
[2] See Tonn, Rose and Hawkins, 2014a. *Weatherization – Beyond the Numbers: Case Studies of Fifteen High-Performing Weatherization Agencies - Conducted May 2011 – July 2012.*

staff). “Diffusion” is defined herein as the process in which new ideas or innovations are communicated over time through members within a social network (Rogers 2003) and diffusion research explores the “capacity for networks to either promote or constrain the spread” of these new ideas (Adams 2010).

Four key findings were revealed: (1) weatherization experiences are indeed communicated through social networks; (2) communications do influence action and behaviors as measured by counts of reported contacts with professional weatherization providers, completing “Do-It-Yourself” (DIY) home projects, and reported changes in energy conserving behavior; (3) WAP recipients can be trained to extract targeted information that might have otherwise been unattainable; and (4) opportunities exist to maximize the impact of social networks (i.e., provide individualized and transformative education and awareness for recipient understanding and adoption of energy and non-energy related behavior based on underlying motivating factors and existing values).

Findings from the interviews reveal that weatherization information diffused into social networks does in fact influence home energy related actions and behaviors. Taking action is defined in this study as contacting a WAP agency, or a private contractor, or completing any DIY projects. Of those interviewed, 37% reported that they contacted a WAP agency, 7% contacted a private contractor or a home energy savings program, and 28% completed some type of DIY weatherization measures. After making initial contact, 91% of those who contacted a local WAP agency filled out an application for services resulting in 54% of those having at least an audit completed. Of those that contacted a non-WAP provider for weatherization services, 61% had an audit or weatherization work completed. These are valuable findings evidencing that WAP recipients can influence investments in energy conservation measures within and beyond the WAP income eligible population.

The WE Project found that the motivating factors contributing to energy saving action involve both self-serving (e.g. energy affordability, home comfort, and health) and altruistic benefits (e.g., environmental conservation). Also found was a statistically significant correlation between those who contacted a private contractor and those reporting being motivated to take action out of concern for the environment. For this group, environmental conservation was the most reported motivating factor. For those who contacted a WAP provider, the top two statistically significant reported motivating factors were “cold winter” and “difficulty paying utility bills.”

Results from the completed interviews offer insight into program utilization process and provide data for secondary impact analysis of WAP’s influence on home energy conservation. This research also sought to contribute to the general discussion on the impact of communicating personal or professional experiences with home-related energy efficiency activities and experiences on the actions and adopted behavior of individuals with whom the information was shared. To expound on the study’s results, this report explores the potential utilization of existing social networks for the diffusion of novel home energy saving information, public health education related to indoor environmental quality (IEQ), and climate change mitigation and adaptation strategies benefiting vulnerable persons and populations, such as those targeted by WAP.

1. INTRODUCTION

This report is part of the Recovery Act period national evaluation of the U.S. Department of Energy's (DOE) Weatherization Assistance Program (WAP). The evaluation is being managed by Oak Ridge National Laboratory (ORNL) on behalf of DOE. The pages that follow present findings from one of several components of the WAP evaluation, a social network study, the Weatherization Experiences (WE) Project, conducted with the intent of capturing additional energy and non-energy impacts attributable to WAP. The study provided the opportunity to assess the potential impact and utilization of existing social networks for the diffusion of information related to home energy efficiency, indoor environmental quality (IEQ) and comfort, and climate change mitigation and adaptation strategies benefiting vulnerable persons and populations, such as those targeted by WAP.

WAP was created by Congress in 1976 under Title IV of the Energy Conservation and Production Act. The purpose and scope of the Program as currently stated in the Code of Federal Regulations (CFR) 10 CFR 440.1 is "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden." (Code of Federal Regulations, 2011)

WAP provides grants, guidance, and other support to Grantees: weatherization programs administered by each of the 50 states, the District of Columbia, territories and several Native American tribes. The Grantees, in turn, oversee a network of 900+ local community action agencies, nonprofit organizations, and local government agencies that are eligible to receive weatherization funding from DOE (Subgrantees). These Subgrantees qualify income-eligible households, assess their homes' energy efficiency opportunities, install energy-saving measures, and inspect each home post-weatherization. Common weatherization measures include: air sealing, wall and attic insulation, duct sealing, furnace repair and replacement, as well as home improvements needed to ensure the health and safety of household occupants. The work is done at no cost to the eligible participants.

Individuals belong to complex webs of social networks comprised of multiple types of relationships, interactions and functions. "Social networks" is defined in this report as a self-identified set of dyadic (group of two) social relationships or interactions (e.g., kinship, friends, and neighbors). The goal of this special study was to explore linkages between individuals within these multi-level and multi-relational social systems starting with the initial communication by the WAP agency, staff, or recipient. In this report we refer to these potential catalysts for spurring home energy-efficiency as "nodes." This reading of the community helps understand if and what type of weatherization information is being shared (i.e., cost savings, health benefits), what core values are in place that might support or hinder adoption of new energy usage behaviors, and the motivating factors contributing to action taken after information is received from a known, or trusted source.

It was hypothesized that weatherization impacts, or stories shared within social networks, influences others to take action. For example, is the story of the two children no longer requiring asthma inhalers after weatherization *communicated* to other parents or to healthcare professionals? Is the testimonial of a child's chronic nosebleeds caused by extreme dry air completely treated after receiving an operable air conditioner through WAP *remembered*? Does the story of the family that no longer has to sleep on mattresses next to the wood stove to reduce exposure to extreme cold *influence* others to assess their own comfort and safety?

To conduct the WE Project, weatherization staff and recipients of the program were recruited to conduct interviews with members of their social network that they had shared information with about

weatherization. The goal of the interviews was to unearth whether or not their experience with weatherization incited actions taken to increase home energy efficiency and better understand the motivations for those actions. The interviews sought to answer five overarching questions through the efforts of the researchers; *Who did you tell? What did you say? What did they hear? What did they do? and Why?*

Section 2.0 of this report contains a discussion of the research related to the diffusion of information or innovation and, more specifically, the role of social networks in diffusing information related to home energy efficiency and the implications for WAP as part of a larger U.S. and global agenda aimed at reducing energy consumption, GHG (greenhouse gas) emissions, and fuel poverty. Section 3.0 provides the methodology and analysis employed to capture the impact of WAP recipient communications and sections 4.0 and 5.0 discuss those impacts and other insights gleaned from the research. Section 6.0 provides conclusions based on the data and existing body of research relevant to the topics discussed. Appendixes A through C offer materials and instruments used for training purposes and for data collection.

2. THE DIFFUSION OF INFORMATION WITHIN SOCIAL NETWORKS

Network research is conducted across the physical and social sciences, and across disciplines from psychology to economics (Borgatti et al. 2009). Social scientists use social network analysis and research to help explain social phenomena. To accomplish this, network researchers look for node attributes (e.g., the number of direct connections a node has and if it acts as a bridge or connector to other nodes, known as "degree centrality") and network attributes (e.g., whether or not a network is dominated by a few central nodes that if removed could cut off vital communication to other parts of the network, known as "network centrality")[3]. Other characteristics assessed include: how well a node is situated between other nodes ("betweenness centrality"), and the length of the path to all others and visibility over what is happening within the network ("closeness centrality"). Network research suggests that determining the nodes who actively communicate information and influence actions (known as "egos") is a good start to understanding the flow of information through a network, but it is also important to know where their connections lead and how they connect to the otherwise unconnected. Also to consider is the power a highly centralized node embodies as they may have influence over what information flows through a network and what does not. Finally, it is vital to determine any points of failure within a network; a highly centralized network (dominated by one or two highly central nodes) risks quickly fragmenting into unconnected subnetworks, whereas a less centralized network may still fail, but offers opportunity for reorganization and repair. When considering the WAP network, it is important to consider the location of nodes and their proximity to the information "hubs" (the weatherization experts and recipients) and their connections to others in their networks that may otherwise remain uninformed of the co-benefits of weatherization. Finally, what happens to the diffusion of information related to home energy efficiency if the program, as a network itself, diminishes in size and scope and reach?

Diffusion research and exploring the role of social networks has been used to better understand the spread of new ideas or innovations related to public health issues and campaigns, homeland security, technology deployment and marketing, and for policy studies. "Diffusion" is the process in which new ideas or innovations are communicated over time through members within a social network (Rogers 2003). Diffusion research explores the "capacity for networks to either promote or constrain the spread" of these new ideas (Adams 2010). Multiple factors exist to explain the varying rate of adoption of novel technologies or innovative ideas. Rogers (2003) suggests five factors that help predict diffusion or adoption rates of an innovation. The two most important predicting attributes involve (1) the innovation's relative advantage (e.g., economic, social prestige, convenience and satisfaction) over existing options, and (2) compatibility with existing social norms and values. The remaining explanations provided by Rogers to help understand differing rates of adoption include (3) the complexity of the innovation, (4) its trialability and (5) its observability. If a new idea or technology is too difficult to understand it might be adopted more slowly or risks being dismissed entirely for being too complex. However, if an innovation can be experimented with on a smaller scale (trialability), to prove its advantages or benefits, it is better able to squelch uncertainty concerns prior to full adoption. Finally, if the relative advantages or results described above can be readily observed the more readily the idea is adopted. The characteristics put forth by Rogers help explain the diffusion of information related to weatherization, home energy efficiency, and renewable technologies available at the household level. Also to consider is the visibility of weatherization work, especially in residential neighborhoods, and opportunities for observability by neighbors and others visiting the residence. Centola (2010) posits that individual adoption of behavior is more likely if those individuals received social reinforcement from multiple neighbors within their social networks. These explanations working in concert with the sharing of experiences through social networks help us further understand the adoption of home energy efficiency technologies and utilization of weatherization program services.

[3] Brief overview of social network analysis provided here was retrieved from; http://orgnet.com/index.html

Research data analyzed through this study suggests that recipients of WAP communicate benefits related to its relative advantages over *not* pursuing home energy retrofits in the following areas; energy cost savings, home comfort, and indoor environmental quality. Weatherization as delivered through WAP does not require any major changes in energy consuming behavior nor does it involve major home reconstruction or rehabilitation[4]. Therefore, it does not risk being perceived as incompatible with existing social norms or values. WAP does not require trialability of energy efficiency measures because it is a service provided at no cost to income-eligible households and offers minimal risk of increased utility costs or hazards. Because WAP is delivered by building science experts and as occupants are educated on the operations of newer technologies, WAP is not viewed as too complex. In fact, this was never a criticism voiced through the interviews conducted through this project. Finally, the benefits of WAP can be immediately observed through utility bills, perceived comfort, and environmental quality. These benefits might then be shared with family, friends, neighbors, and other members of social networks. Interestingly, managing staff for WAP in Puerto Rico commented on the role of social networks in their culture. They reported that prior to WAP, the government in Puerto Rico offered rebates for housing related energy-efficiency technologies. The rebates offered in this specific example were not utilized by the public at the rate expected with the explanation that the rebates were described as being "too complex" within the public's social networks in Puerto Rico. These same informants reported the need for additional WAP application call centers in Puerto Rico once the new program was offered and its benefits were communicated through the public's social networks.

A recent study conducted to explore the influence of social networks on weatherization program utilization suggests that word of mouth communication related to positive experiences with home energy efficiency and weatherization is a predicting variable for others securing weatherization services or activities "over and above the influence of one's energy related knowledge" (Southwell & Murphy 2014). Hearing about another's experience with weatherization influences one's decision making related to home energy efficiency. This is important to consider when engaging and educating recipients of home energy programs who may share their life experiences with others. As members of social networks, recipients of WAP become nodes of communication harboring the potential to influence others to take home energy conservation action. More specifically, these recipients are able to influence decisions based on DOE's WAP; a program that offers relative advantage over continuing to reside in a potentially inefficient home. WAP has the ability to be successfully messaged through these social networks as it; (1) offers minimal perceived risk as a service offered at no cost to the eligible applicant; (2) does not compete with social norms as its measures target the building envelope and a home's energy consuming equipment; (3) has proven results; and (4) is not overly complex.

Other research investigating energy and environmental related decision making suggests two overarching camps of motivation related to home energy saving actions. The first camp is concerned with self-interests such as well-being and utility costs. The second group responds out of altruistic concern such as environmental conservation to mitigate climate change (Dietz 2015; Arsenio & Delmas 2015). The research presented by these authors suggests socio-economic status (SES) and political affiliation factor into decision making and argue that framing home energy conservation campaigns and programs according to the target audience or stakeholder might achieve improved outcomes.

[4] Although major home rehabilitation may occur alongside WAP through leveraged resources secured by the providing agency, this type of activity is outside the scope and rules governing WAP.

3. METHODOLOGY

This study serves to identify and map ways in which DOE's WAP encourages secondary impacts on home energy savings through social networks. It attempts to identify benefits achieved beyond the program as a result of two categories of stakeholder in the weatherization process potentially influencing energy savings and the benefits related to those savings beyond their homes and their day-jobs. These two categories of people are the WAP recipients and the weatherization staff. In the case of the recipients, members of the household might tell their friends and family (within and beyond the WAP income-eligible community) about the results of their home energy audits, weatherization measures installed, changes in their energy bills and comfort, and other impacts related to energy and non-energy benefits. In the case of the agency staff, weatherization auditors and technicians are known to work with households of low to high SES employing the skills attained through WAP training. Staff might also be influencing program utilization, and reduction of residential energy consumption through financial investments and behavior modification within their own social networks.

The WAP national evaluation's occupant satisfaction survey[5], administered to a random sample of WAP recipients, found that 79% of those who received WAP told others about the program and that 19% said that the person they told then received services (Table 3.1).

Table 3.1. Results from the WAP National Evaluation Occupant Satisfaction Survey; Word of Mouth Communication

In the past 12 months, have you told other people who might be interested in receiving weatherization services about the program?	
Number of Respondents	**659**
Told others about the program	79%
Did not tell others about the program	21%
TOTAL	100%
Have those people had their homes weatherized, or are they scheduled to have their home weatherized, as a result of your suggestion	
Number of Respondents	**659**
They got weatherized/scheduled to be weatherized	19%
They did not receive services	23%
Did not tell others about the program	21%
Don't know	38%
TOTAL	100%

This study was designed to further explore whether or not our culture's natural tendency to share information through casual communication within social networks involved shared experiences with WAP. It seeks to analyze the influence of recipients and staff as known, or trusted sources on members within their social networks and is designed to answer the following overarching research questions; Are recipients and staff of the program sharing their experiences? What about their experience is being shared? What is being remembered? Is the information shared influencing members of their social networks in the areas of program utilization, investments in energy efficiency, and modification of energy consuming behaviors? Is the weatherization experience shared beyond this first round of communication

[5] Carroll et al. 2014a.

potentially influencing other members within additional social networks? By soliciting broad information the respondent might volunteer unanticipated information beyond the scope of initial ORNL researcher knowledge. In addition to frequencies of topics shared and remembered, ORNL researchers investigated the impact of shared communication as measured by self-reported program utilization, household energy use behavior, and investment in energy efficiency and weatherization measures.

Participatory research techniques were employed for gathering occupant data from the household nodes and in creating a social network map starting with the initial recipient node. Local recipients of the program were recruited through the local agencies as researchers. Researchers selected were assumed to be well versed in the culture of the area, have good interpersonal skills, and be knowledgeable of the WAP application and program process. Trained researchers were asked to make contact with the initial recipient nodes with specific attention to whether or not their shared experiences may have served as a catalyst for home energy changes within the community or social network, or if they were influenced by a household that could better be identified as such.

Utilization of participatory techniques within client populations and partnering with community agencies aligns itself with the Open Government Directive, managed by the Office of Management and Budget (OMB), espousing the need to incorporate transparency, participation, and collaboration with multi-disciplinary approaches into design, implementation and analysis of federal programs and projects. The capacity building component of participatory research offers empowerment and experience extending the individual's employment opportunities and recognizes members of target populations as potential catalysts for effecting change in the areas of fuel poverty, IEQ, and environmental impacts from energy consumption.

To conduct the WE Project 10 local weatherization agencies that had been purposively selected for the WAP national evaluation case study report[6] were asked to recruit staff members and recent program recipients that may be interested in participating. Many of the weatherization agencies delivering WAP are Community Action Agencies (CAAs). CAAs were first established during the Johnson administration's War on Poverty as part of a strategy to combat rising poverty rates during the 1960s. Having been embedded in the communities they serve for several decades and due to their continued use as umbrella programs for a wide-range of government, private and philanthropic funding, these social service organizations were assumed to have an established level of trust with their clients. Because of this attribute, it was anticipated they would have greater success with "cold calls" conducted during the recruitment phase to explain ORNL's research project and to establish interest and a commitment to participate.

Criteria were provided to agencies to assist with the recruitment process for the 'interviewer' sample (Table 3.2); program recipients were to have had their homes weatherized within six months and willing to be trained on how to collect information from members of their social networks through in-depth, guided interviews. This participatory research technique allowed for information to be collected starting with the initial recipient or staff as a node of communication. This technique was anticipated to increase the interview response rate. Interviewers were trained in a 3-4 hour workshop facilitated on-site at the agency by research professionals through ORNL and by other social scientists subcontracted for this task. This workshop included a presentation explaining the WE Project and several role playing exercises. Once trained, the now "researchers" administered semi-structured interviews to members of their own social networks utilizing open-ended questionnaires provided during the workshop sessions. Although interviewers were permitted to conduct interviews using different modes of communication, all were reportedly administered in-person or via telephone.

[6] See Tonn, Rose and Hawkins, 2014a. *Weatherization – Beyond the Numbers: Case Studies of Fifteen High-Performing Weatherization Agencies - Conducted May 2011 – July 2012.*

The interviewers were also requested to ask their interviewees (the 'respondent' sample) if they had discussed weatherization with anyone within *their* social network (the '2nd round respondent sample') and if so could they provide names and contact information in order to interview them as well (Figure 3.1). The researchers were asked to devote 20 hours over a two week period to complete their interviews. The interviews were conducted with the guarantee that the trained researchers would de-identify the interviews prior to them being sent to ORNL analysts. Trained researchers who sent the de-identified, coded questionnaires back to ORNL researchers for analysis were then compensated $400 for their time. In the end, 58 WAP recipients and 16 agency staff delivered 777 de-identified completed interviews - 538 were from 1st round respondents and 239 were from 2nd round respondents.

Table 3.2. Criterion for Selection

Agency Sample (n=10)	• Agencies purposively selected for WAP Evaluation Case Studies were asked to recruit interested staff and recipients of the program
Interviewer Sample (n=74)	• Program recipient weatherized within last 6 months (n=58) or staff of WAP agency (n=16) • Willing to be trained and to conduct semi-structured guided questionnaires with members of their social networks • Willing to conduct a second round of interviews from a snowball sample attained through the first round of interviews • Participation in a training workshop
Respondent Sample (n=777)	• Round 1: Member of Interviewer's Social Network (n= 538) • Round 2: Member of Respondent's Social Network (n=239)

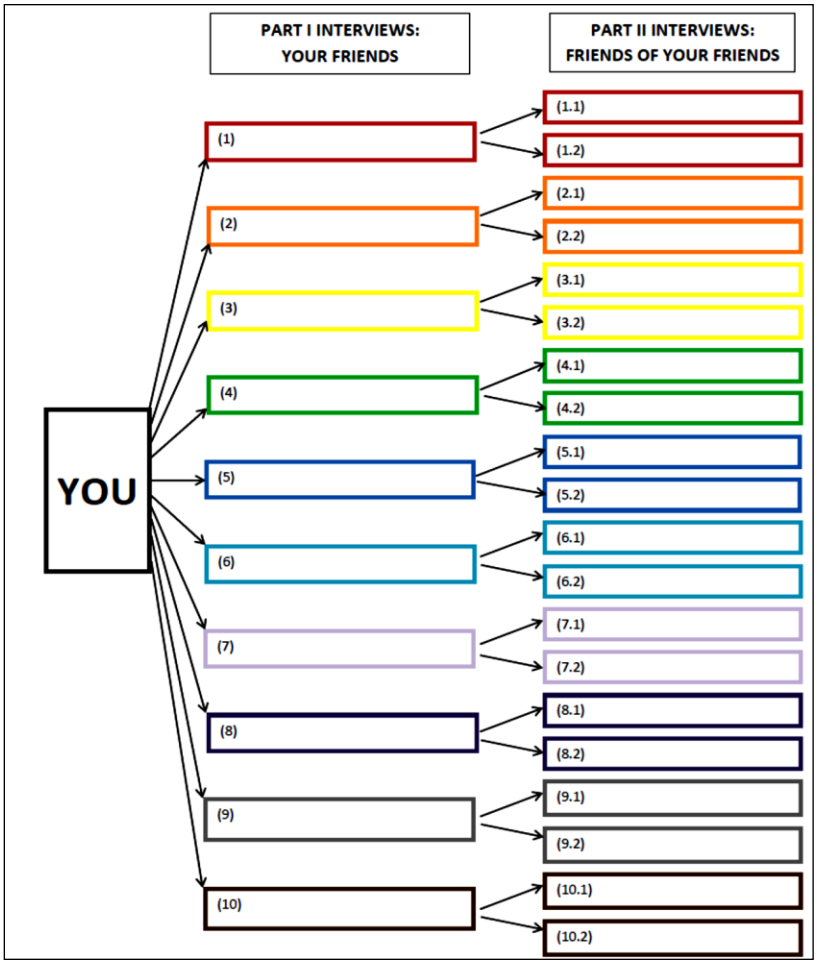

Figure 3.1. Interview Guide

The Agency Sample

The 10 participating agencies covered a range of program types, regions and climate zones and included seven CAAs and three Housing Rehabilitation Organizations, one of which was a Tribal Organization (Figure 3.2). Five of the CAAs included an additional element as part of their weatherization delivery; four provided a focused energy education session and one provided Weatherization plus Health services.

Community Action Agencies – (traditional WAP subgrantees with standard program features)

- Knoxville-Knox County Community Action Committee - Tennessee
- Corporation of Ohio Appalachian Development (COAD) – Marietta, OH

Community Action Agencies – (traditional WAP subgrantees with additional elements to weatherization delivery)

- Focus on Energy Education
  - Central Vermont Community Action Council (CVCAC) – Barre, Vermont
  - Commission on Economic Opportunity (CEO) – Wilkes-Barre, Pennsylvania
  - Social Development Commission (SDC) – Milwaukee, Wisconsin

- Focus on Weatherization plus Health
  - Opportunity Council - Bellingham, Washington (Weatherization plus Health)
  - Community Action Partnership Association of Idaho (CAPAI) – Lewiston, ID

Housing Rehabilitation Organizations

- St. Johns Housing Partnership – St. Augustine, Florida
- Housing Resources of Western Colorado – Grand Junction
- Salish-Kootenai Housing Authority – Pablo, Montana (Tribal Organization)

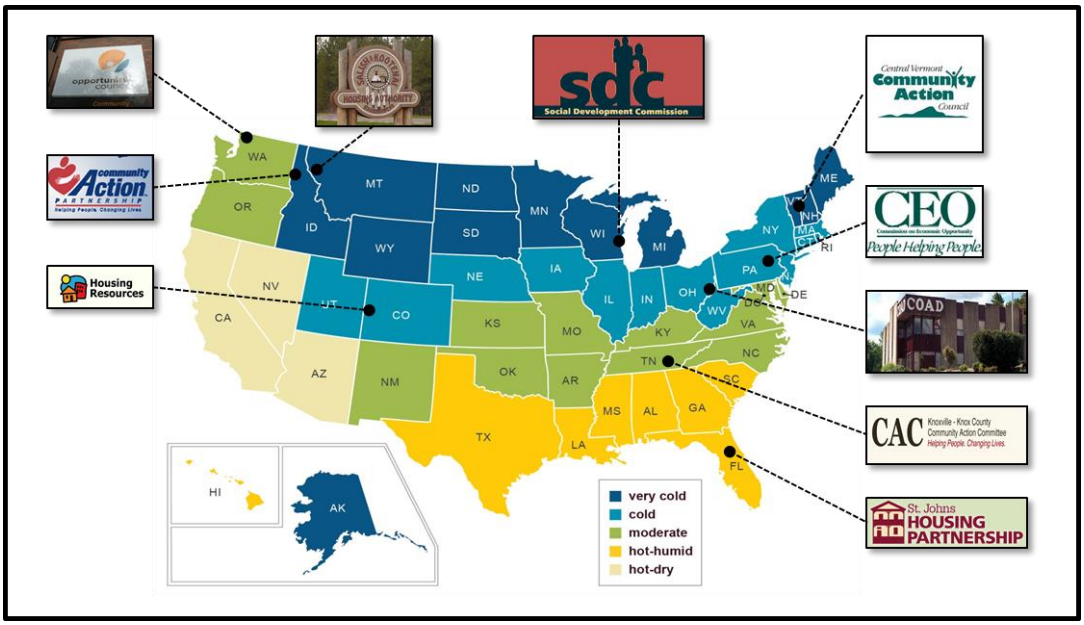

Figure 3.2. Agency Sample

Survey Instrument Development and Analysis

Semi-structured guided interviews were developed in efforts to capture; (1) whether or not weatherization experiences are being shared; (2) details shared; (3) details remembered; and (4) any influence those experiences or other factors have had on action or non-action related to home energy efficiency. Interview guides were pre-tested with the Knox County CAC in Knoxville, TN and were modified to address comments, observations, and confusion regarding the order and wording of questions. The final iteration of the guide (Appendix C) included topics and prompts in the following categories:

- *What was remembered*: Interviewers were requested to first establish whether or not the person being interviewed remembered hearing about the weatherization completed, about their own work with weatherization (DIY projects), or ways they have learned to save energy. Upon establishing this, interviewees were asked what it is they remembered about the conversation.

- *Action taken*: Upon determining if the communication related to weatherization was remembered and what was remembered, interviewees were then asked if they took action based on the information received from the WAP recipient or staff's experience with weatherization.

Responses were categorized into actions related to contacting a WAP agency or private contractor, DIY projects, and changes in home energy consuming behaviors.

- *Respondent experience*: If the respondent reported taking any kind of weatherization or home energy consuming behavior action, questions were asked related to the respondent's experience with that action. Interviewers attempted to determine how actions might have impacted the household members in the areas of cost, comfort, health, and environmental quality.

- *Motivations, values and obstacles*: Interviewers were asked to help the respondent determine what it was that motivated them to take action, what value systems were in place underlying the motivating factors, or if no action was taken, what the obstacles or barriers were that interfered with action being taken.

- *Social Media*: Access to social media, and even to its precursors (e.g., old fashioned letter writing) offers a starting point to any communication about the personal cost savings and other benefits inherent in weatherization. "Social media" included the existing forums in Twitter, Facebook, blogs, online listservs and groups. Respondents were asked if they shared their or others' experiences with weatherization using social media.

- *Further sharing*: Finally, at the end of the interview, respondents were asked if they had shared the initial respondent's or their own experience with weatherization or home energy efficiency with others. If so, that respondent was asked for the name and contact information for two individuals to be contacted for an additional round of interviews.

In addition to these topic areas, the interviewers were asked to determine the state or country the interviewee resided in, if anyone in the home was over the age of 65, if there were persons with disabilities in the home, and if there were young children in the home. These are the primary high-priority households targeted by WAP.

Interview responses were coded for data input and analysis using the Statistical Package for the Social Sciences (SPSS) software often employed for social science survey research. A total of 316 variables were created to capture all of the interviewer and respondent characteristics and open-ended interview responses. The questionnaires were also combed for notable descriptions of experiences to ensure the voice of program recipients and members of their social networks was captured alongside the quantitative findings.

Social Network Analysis (SNA) software was employed to further explore linkages between individual households, weatherization staff, and agencies as nodes within multi-level and multi-relational social systems that could influence energy savings beyond WAP. SNA allowed evaluators to capture the structural attributes of the network and relational data to provide visual analysis. The open-source software, Gephi, was used for this network visualization task and will be further described in Section 5.

The timeframe for this project extended from March 2011 through March 2015 to allow time for the adoption of culturally sensitive implementation plans for each agency, hiring and training of researchers (recipients and program staff), sampling, interviewing, data input and analysis, and report writing.

Research Limitations

Exploring node and household attributes was limited to basic, non-invasive descriptors. Questions related to the *type* of relationship between the interviewers and interviewees were not asked. Characteristics or demographics commonly collected for SNA that could have made this study more insightful include;

race, ethnicity, religion, political affiliation, gender, age, employment, owner/renter status, income, health status, and general sociability. However, these questions were not asked as we did not want to make either the interviewer or interviewee uncomfortable with asking personal questions that may have reduced the likelihood of interview completion.

Data collected through the WE Project was self-reported, which introduces an element of bias for this type of exploratory research. ORNL staff was unable to conduct quality assurance during the interviewing process as the interviews were unsupervised and not recorded to ensure anonymity. Lastly, the interpretation of open-ended responses for data coding introduced a potential for subjectivity. ORNL analysts conducted thorough quality assurance activities to ensure responses were coded accurately.

4. WEATHERIZATION SHARED THROUGH SOCIAL NETWORKS

Findings from the interviews conducted by WAP recipients and staff provide the sought out answers regarding the type, flow and impact of information related to weatherization communicated within social networks. Dyadic ties (relationships between two people) can be bucketed into four basic types: similarities, social relations, interactions, and flows (Borgatti et al. 2009). In this report we focus on the communication flow of weatherization experiences between individuals with social relations and the outcomes from those interactions. Most importantly, we determine if individuals connected to WAP are indeed sharing information related to weatherization as anecdotal evidence suggests. If so, what are the impacts of that shared information? This section provides; (1) descriptive statistics to help characterize the WAP recipients and staff participating in this study in efforts to determine attributes that might contribute to the diffusion of information; (2) findings that reveal which topics are being shared and remembered within social networks; and (3) correlating factors between who is sharing, what is shared, and impacts of that shared information.

4.1 SAMPLE CHARACTERIZATION

WE interviewer participants were characterized by gender and by type; WAP recipient or staff (Table 4.1). It should be noted again that data were not collected on gender, income, or employment (more specifically, if they were weatherization staff) for this group. Thus, this characterization of participants only applies to the initial nodes, or interviewers. The majority of the project interviewers were WAP recipients (80%) and female (74%) with only 7% of the females being weatherization staff. It is not surprising that the majority of the participating weatherization staff were male (67%) based on results from ORNL's Weatherization Staff survey[7] which concludes that more males than females deliver WAP services at the household level. On average, a program recipient completed 10 interviews and staff completed 14. Ultimately, female WAP recipients (68%) furnished the majority of the interviews (63%) used to depict the social networks for this study (Table 4.2).

Table 4.1. Characterization of WE Project Interviewers by Gender and Type (Program Recipient or Staff)

Interviewer Sample by Gender	Type of Interviewer	
Whole Interviewer Sample n=74	**Program Recipient n=59 (80%)**	**Staff n=15 (20%)**
Female: n=55 (74%)	n=50 (68%)	n=5 (7%)
Male: n=19 (26%)	n=9 (12%)	n=10 (13%)

Table 4.2. Furnished Interview Data by Gender and Type (Program Recipient or Staff)

Interviews Completed n=777	Type of Interviewer		Interview Round	
Furnished by:	**Program Recipient n=577 (74%)**	**Staff n=200 (26%)**	**First n=538 (69%)**	**Second n=239 (31%)**
Female: n=567 (73%)	n=487 (63%)	n=77 (10%)	n=391 (73%)	n=173 (72%)
Male: n=210 (27%)	n=90 (11%)	n=123 (16%)	n=147 (27%)	n=66 (28%)

To begin the interviews, the trained WAP recipients and staff asked members of their social networks, called upon for an interview, if they remembered the interviewer communicating either their experience

[7] % by weatherization job type: Auditor, 93%; Crew Chief, 98% and Crew Member, 97%. See Carroll et. al. (2014b).

or work related to weatherization; 99% of respondents remembered hearing about the weatherization. When the interviewers asked these same members of their social networks (interviewees) if they talked with any of *their* friends or family about the information they heard or about their own experiences with weatherization, 52% reported that they did. The weatherization message continues to spread out into a third degree of separation with 44% of the second round respondents reporting conversations about weatherization with someone in *their* social network. Of those who reported communicating their experiences with members of their own social networks, more than 60% of both rounds relayed information to up to three people and 10% of both rounds reported talking to more than ten people about weatherization (Table 4.3).

Table 4.3. The Number of People Respondents Remember Talking to After Hearing about Weatherization, Per Round (by %)

# of people	Round 1 (n=240)	Round 2 (n= 93)
1-3	60%	69%
4-6	21%	18%
7-9	3%	2%
10+	10%	10%
Don't know	6%	1%

Analysts were able to determine primary modes of communication used to relay the information. The majority of interviewers used both telephone and in-person interaction to communicate their experiences with weatherization; 75% and 71% respectively. Only 8% of interviewers reported use of social media (e.g., Facebook, twitter, blog or other) as a mode of communicating their weatherization experiences.

4.2 IMPACTS OF SOCIAL NETWORK INTERACTION

Impact of interactions was measured through; (1) the number of people motivated to 'take action'; (2) the relevance or impact of communication (based on information shared vs. information remembered); and (3) changes in home energy consuming behavior upon receiving information regarding weatherization from WAP recipients and staff.

Taking Action

Findings from the interviews reveal that weatherization information diffused into social networks does in fact influence related actions and behaviors (Table 4.4). Taking action is defined here as contacting a WAP agency or a private contractor or completing any DIY projects: 37% reported that they contacted a WAP agency, 7% contacted a private contractor or a home energy savings program and 28% completed some type of DIY weatherization measures. After making initial contact, 91% of those who contacted a local WAP agency filled out an application for services resulting in 54% of those having at least an audit completed. Of those that contacted a non-WAP provider for weatherization services, 61% had an audit or weatherization work completed. These are valuable findings evidencing that WAP recipients can influence investments in energy conservation measures within and beyond the WAP income eligible population. Table 4.4 also presents the type and frequency of DIY measures installed.

Table 4.4. Did Information Heard Result In Action Taken?*

41% contacted at least one weatherization provider (n=311)	Percent
Contacted a WAP agency	37% (n=286)
Filled out application	91%
Had an audit or weatherization completed	54%
Reported being ineligible for WAP	10%
Contacted a private contractor or home energy savings program	7% (n=51)
Had an audit or weatherization completed	61%
28% completed DIY measures (n=202)	**Percent**
CFL's	25%
Insulation	18%
Air Sealing	18%
New windows	9%
Heating system replacement	7%
Water savings measures	4%
New door(s)	4%

*Responses are not mutually exclusive

Analyses were conducted to explore relationships between initial node attributes (i.e. gender, WAP recipient, staff, 1st or 2nd round) and observed influence on members of their networks determined by whether or not a respondent contacted someone for more information, completed DIY weatherization, or reported energy use behavior changes (Table 4.5). Respondents were more likely to do DIY projects if the initial communication was delivered by a male (37%) or staff (24%). Findings also suggest that weatherization staff encourage their social networks to contact local weatherization agencies for more information and that the reach of this communication extends beyond their own social networks as evidenced by 70% of the second round respondents reporting contacting an agency for more information. It does appear that in comparison to WAP recipients, weatherization staff has more of an impact on their social networks in all three impact categories created for this study. However, the number of WAP households weatherized per year (~ 100,000) far exceeds the number of program staff resulting in WAP households having a greater overall impact across the U.S.

Table 4.5. Characterization of Initial Node and Level of Impact on Specific Actions Taken By Interview, By 1st And 2nd Round

Interviewer Type (initial recipient node)	Respondent contacted someone for more information		Respondent reported "Do-It-Yourself" Weatherization		Respondent reported behavior action	
Whole Sample	**41%**	**1st: 43%** **2nd: 37%**	**28%**	**1st: 31%** **2nd: 20%**	**55%**	**1st: 59%** **2nd: 50%**
Staff	60%	1st: 54% 2nd: 70%	37%	1st: 47% 2nd: 20%	64%	1st: 69% 2nd: 54%
Program Recipient	34%	1st: 39% 2nd: 22%	24%	1st: 26% 2nd: 20%	52%	1st: 56% 2nd: 44%
Female	40%	1st: 43% 2nd: 35%	24%	1st: 28% 2nd: 15%	55%	1st: 59% 2nd: 46%
Male	43%	1st: 43% 2nd: 43%	37%	1st: 38% 2nd: 33%	56%	1st: 59% 2nd: 50%

More than half of the respondents (55%) reported some sort of energy usage behavior change being inspired by these communications with a trusted source. Table 4.6 presents the top five actions recorded in the interviews, in order, include; (1) turning off lights; (2) unplugging appliances; (3) reading utility bills; (4) adjusting the thermostat; and (5) changing the air filter.

Table 4.6. Energy Usage Behavior Change

Behavior Change Reported by Respondent (n=774)	
Turning off lights	41%
Unplugging appliances	26%
Reading utility bills	21%
Adjusting thermostat	28%
Changing air filter	26%

Information Shared and Heard

Other questions we sought to answer were: Which aspects of the weatherization experience were most shared by the interviewer when weatherization occurred, and what information did the interviewees remember hearing. The topic of weatherization measures installed was the subject most often discussed (97%) by the initial node with energy or cost savings a close second at 94% (Figure 4.1). Next in order were ways to save energy, satisfaction with the program, and personal comfort. Health and safety topics were the least often shared (43%). The percentage of respondents who remembered or *heard* these topics was lower. Most frequently remembered was measures installed (66%) and satisfaction (40%). The drop off from what was heard by the 1st round and heard by the 2nd round was to a lesser degree than the drop from the initial node to the 1st round. These results provide evidence that these messages are being shared and remembered into at least the 2nd degree of separation, but that the messages shared and remembered

change in content and volume. The results also support the theory that the shorter the distance from the key actor or influencer (the actual recipient of WAP or staff) to other nodes in the network the quicker the rate of information diffusion (Borgatti et al. 2009).

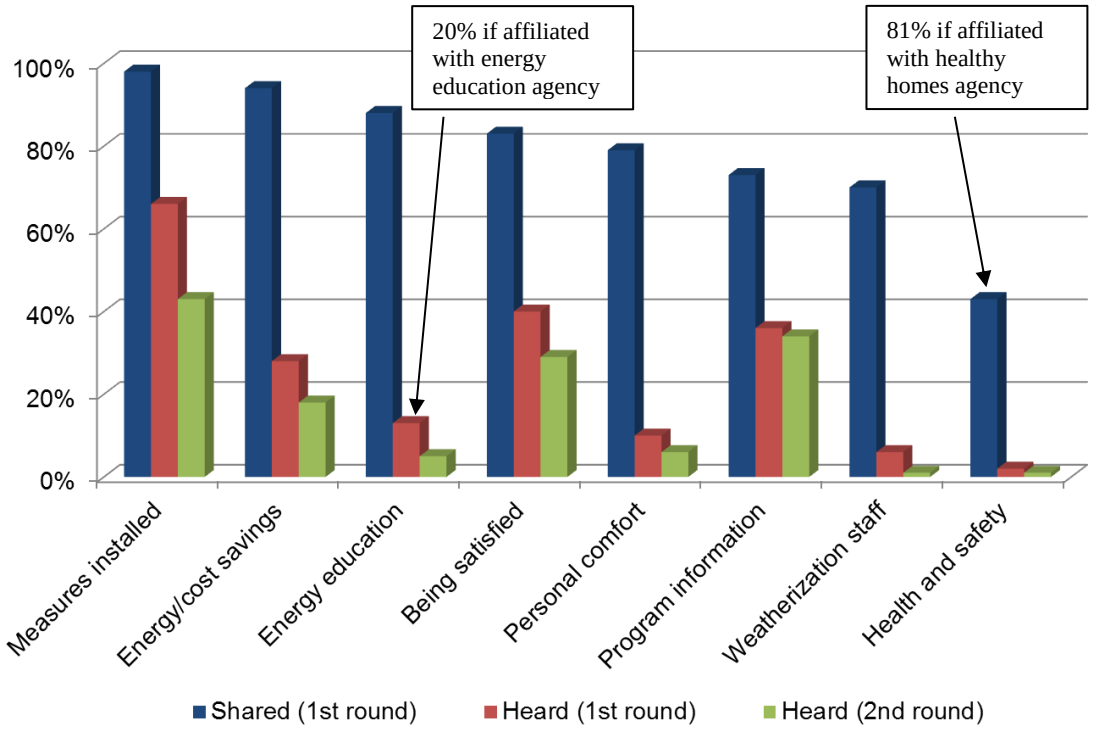

Figure 4.1. Weatherization Topics Shared and Heard, By Round

Some weatherization agencies provide specialized services in addition to energy efficiency measures (e.g., energy education and healthy homes). For the initial nodes affiliated with an agency with a focus on energy education[8], it was reported that 88% remembered discussing this topic with members of their social network. Interestingly, this statistic is similar for the "non-specializing" weatherization agencies. However, the percentage of respondents in the first round that *remembered* hearing about energy education increased from 13% to 20% if the initial node was affiliated with an agency with that specialized focus. These data indicate that regardless of whether or not a program recipient receives concentrated energy education they are talking about it to the same degree, but one could speculate that the additional energy education enabled WAP recipients or staff to articulate or deliver the energy education in such a way that the impact became more memorable.

In contrast, if the initial node received services through an agency with a focus on healthy homes[9], the percentage of those that shared information surrounding health and safety increased substantially from 43% to 81%. However, information surrounding health and safety topics are the least remembered regardless of whether or not the agency specialized in healthy housing. These findings suggest there are opportunities to improve the utilization of social networks for the purpose of diffusing critical public health education related to indoor environmental exposure to hazards and contaminants.

[8] Central Vermont Community Action Council (CVCAC) – Barre, Vermont; Commission on Economic Opportunity (CEO) – Wilkes-Barre, Pennsylvania; and Social Development Commission (SDC) – Milwaukee, Wisconsin.
[9] Opportunity Council - Bellingham, Washington (Weatherization plus Health) and Community Action Partnership Association of Idaho (CAPAI) – Lewiston, ID.

Information surrounding specific IEQ and health topics reportedly shared by the initial node is presented in Figure 4.2. Regarding IEQ, increased comfort was shared 58% of the time and observed decreases in drafts were shared in 49% of cases. Improved health in general was shared in 11% of cases, followed by decreased asthma triggers and need to use medications (both at 6%). Captured in the surveys but least shared were specific health issues such as a decrease in cold symptoms (4%) or episodes of Bronchitis (2%).

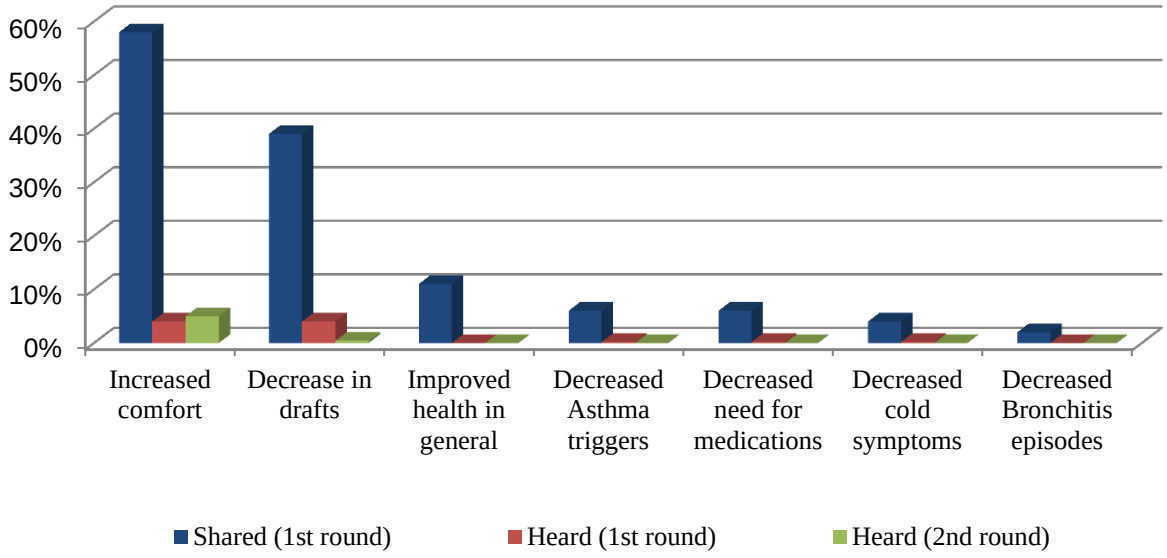

Figure 4.2. IEQ and Health Topics- Shared and Remembered

Members of social networks who had weatherization work completed at the suggestion of other WAP recipients reported observations related to IEQ post-weatherization. Of those who had weatherization work completed through WAP (see Table 4.7), close to half reported less drafts, humidity, and dust in the home and that the air just "seemed cleaner." With respect to health benefits, 15% reported feeling healthier in general; 13-14% reported a decrease in episodes of shortness of breath, asthma symptoms, allergies, persistent cold symptoms and/or lung irritation/cough. Results from the national occupant survey administered through the WAP evaluation suggest that one year after weatherization respondents and other household members experienced a wide range of health and well-being benefits similar to the ones reported here.[10]

[10] See Tonn et al. 2014c. *Health and Household-Related Benefits Attributable to the Weatherization Assistance Program.*

Table 4.7. Reported Changes in IEQ Post-Weatherization through WAP by Respondents

Reported by Respondent Post-Weatherization (n=276)	
Less drafts	55%
Air seems cleaner	54%
Air is less humid	51%
Air is less dusty	44%
Air is less moldy	34%
Feels healthier in general	15%
Decreased episodes of shortness of breath or asthma symptoms	14%
Decreased episodes of allergies/persistent cold symptoms	14%
Decreased episodes of lung irritation/cough	13%

Opportunities for additional comments from the respondents were provided during the interview process.

Several pages of notable quotes were compiled from the 777 completed interviews to capture even more of the stories being told. Below are some select quotes related to IEQ and health:

"Less dust and mold – less coughing and congestion than before weatherization."

"*Our home is warm and cozy without the drafts of cold air. We can actually go barefoot and not be dressed in layers."*

"I have M.S. and am prone to pneumonia. With the weatherization work it is easier to breathe, I have stopped using nasal spray, and I've stopped coughing since the work has been done. Thank you so much from the bottom of my heart for your help."

"I am able to pay my utility bill on time now and it has saved me about $60 plus the late fees, because I always had to pay it in two parts. I now can get all of my medicine with the extra money."

"When my grandkids watch TV they don't have on sweaters anymore, and I can let them sit on the floor because it's not cold and drafty. I notice they were not coughing like they used to."

"It has helped my sinus problems; therefore I saved money from going back and forth to my doctor for sinus medicines, antibiotics."

"The house was warmer and safer; I could go out on the porch without falling through."

"Kids are happy and not as sick. We are warmer and sleep better. It is a cleaner, happier house!"

Statistically Significant Correlations

Correlations were generated to explore the statistical significance of the observed relationships between degree of separation, node attributes, topics shared and remembered, and reported energy conserving actions and behavior (Table 4.8).

The analysis suggests relationships exist between type of action and the following variables: degree of separation; if interviewer received services or was a staff member with a CAA agency (as opposed to a housing rehabilitation agency); WAP staff versus program recipient; gender; if respondent's home contained a member of a vulnerable population; and topics remembered and related to energy or cost savings, energy or health related education, and improved comfort.

Table 4.8. Statistically Significant Correlations by Degree of Separation

Statistically Significant Correlating Factors		Contacted WAP	DIY	Contacted Private Contractor	Adopted Energy Saving Behavior	Contacted WAP	DIY	Contacted Private Contractor	Adopted Energy Saving Behavior
		1st Degree of Separation				*2nd Degree of Separation*			
Interviewer Descriptors									
Affiliated CAA Agency	Pearson Correlation	-.094	.224						
	Sig. (2-tailed)	.029	.000						
WAP Staff	Pearson Correlation	.107	.191	.086	.115	.447			.129
	Sig. (2-tailed)	.013	.000	.046	.008	.000			.047
Interviewer was Male	Pearson Correlation		.095				.210		
	Sig. (2-tailed)		.027				.001		
Respondent									
Contacted WAP	Pearson Correlation				.274		-.147		.336
	Sig. (2-tailed)				.000		.023		.000
DIY	Pearson Correlation			.176	.163				
	Sig. (2-tailed)			.000	.000				
Someone > 65 yrs. old in the home	Pearson Correlation	.104				.179			.145
	Sig. (2-tailed)	.018				.008			.033
Someone < 5 yrs. old in the home	Pearson Correlation	.089							.188
	Sig. (2-tailed)	.042							.005
Someone with a disability	Pearson Correlation	.122			.128	.182			
	Sig. (2-tailed)	.005			.004	.007			
Remembered education	Pearson Correlation				.134		.271		.177
	Sig. (2-tailed)				.002		.000		.007
Remembered program details	Pearson Correlation								-.159
	Sig. (2-tailed)								.014
Remembered savings	Pearson Correlation						.185		
	Sig. (2-tailed)						.004		
Remembered improved comfort	Pearson Correlation								.181
	Sig. (2-tailed)								.005
Conversation >6 months ago	Pearson Correlation		.138						
	Sig. (2-tailed)		.003						

Motivations and Values

Understanding motivations and values provides an opportunity to improve the utilization of existing social networks for the diffusion of information and to attain socially desirable behavior within a culture. This study allows us to better understand what it is that drives individuals to seek services from a WAP provider or what it is about hearing another person's shared experience that moves another to act. Finally, do their values help inspire these actions?

Findings show that topics most remembered by the respondents (i.e. installation of weatherization measures) seem to be linked to the top *motivating* factors for the subsequent action of contacting a WAP provider; (1) being cold in the winter; and (2) having difficulty paying utility or other bills (Figure 4.3). Almost half of the respondents reported *valuing* home comfort and money which also align with motivations for contacting a WAP provider. It seems reasonable that more respondents would remember hearing about the installation of measures that are likely to improve energy affordability and comfort of their home in winter. The second topic shared most often by the initial node was energy and cost savings which is consistent with the second most reported motivating factor, difficulty paying bills.

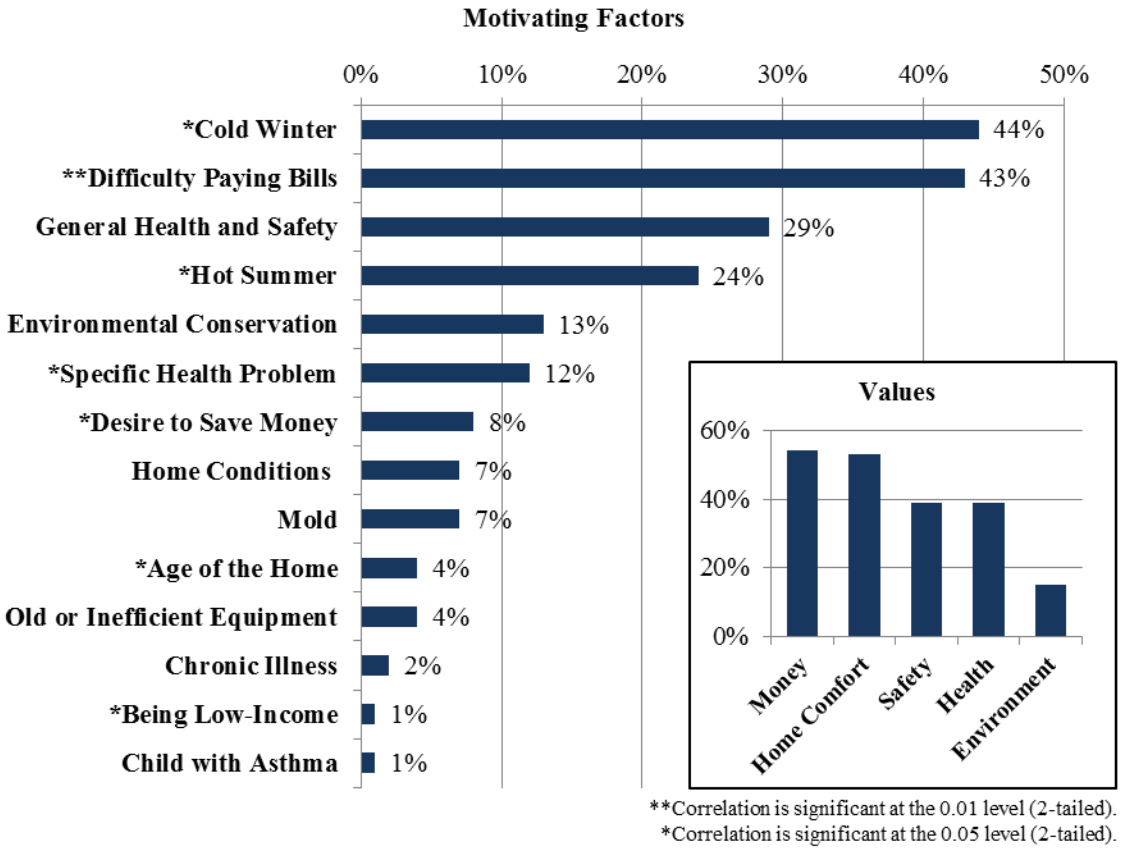

Figure 4.3. Interviewee Reported Motivating Factors For Contacting a WAP Agency and Their Reported Values - Statistically Significant Correlations Between Motivating Factors and Whether Interviewee Contacted a WAP Provider (n=286)

Interestingly, the ordering of reported motivating factors and values of those who contacted a private contractor for weatherization is slightly different than those who contacted a WAP provider. Figure 4.4 shows that environmental conservation is the number one reported motivating factor (and the third most reported value) for contacting a private contractor. Experiencing cold winters is still the second most reported factor, and the desire to save money is the third. It appears as though the reported motivating factors for the two groups that either contacted a WAP provider or a private contractor could be bucketed in the two groups discussed by Dietz; self-interest and altruism. Those who contacted a WAP provider believing to be income eligible reported being motivated mostly by self-interest in the form of comfort and affordability. Those who contacted a private contractor also reported self-interest categories as motivating factors, but the most reported motivating factor (at 29%) was of the altruistic kind; environmental conservation.

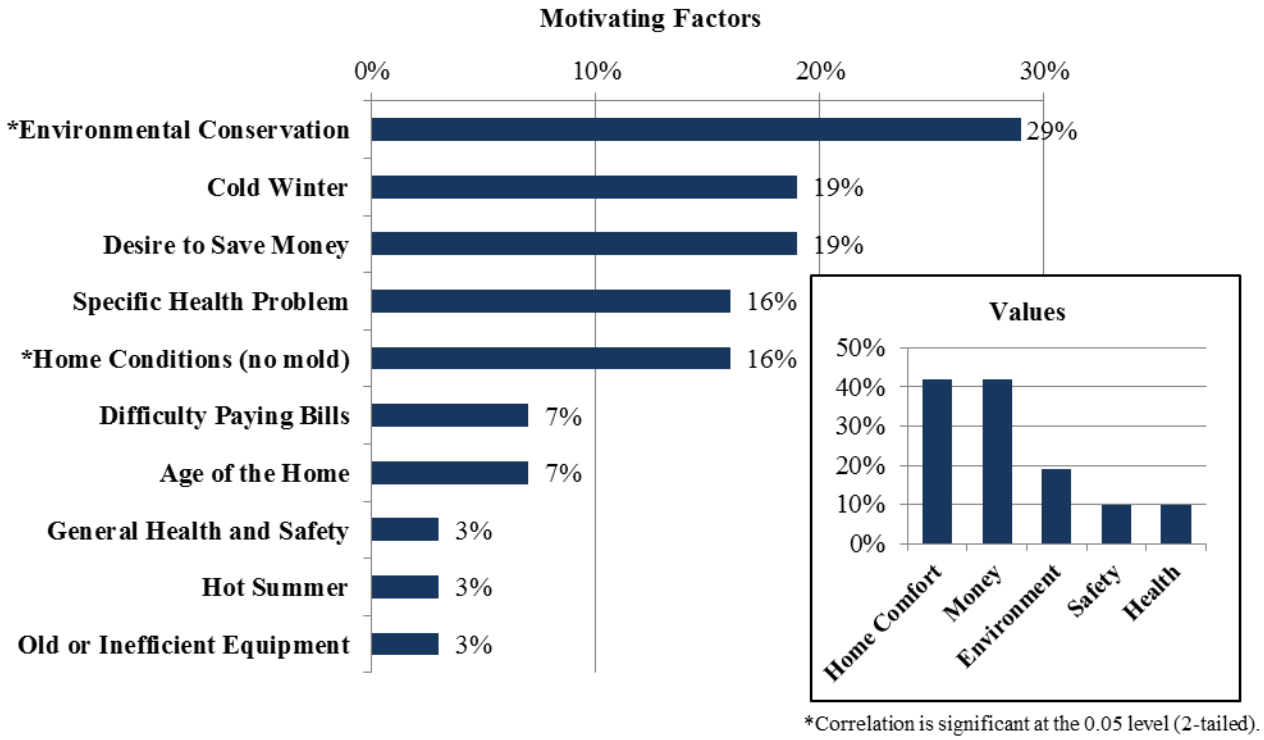

Figure 4.4. Interviewee Reported Motivating Factors for Contacting a Private Contractor and Their Reported Values – Statistically Significant Correlations Between Motivating Factors and Whether an Interviewee Contacted a Private Contractor (n=31)

Obstacles preventing action

Interviewers were tasked with identifying any obstacles or barriers in place that might have kept the 255 respondents from taking any energy saving action at all. Figure 4.5 presents the answers provided; 14% of the 255 respondents reported their homes had already been weatherized. It could be argued that this is more of an explanatory factor rather than an obstacle. However, the fact that 17% reported not being interested in weatherization could reflect the need for more education surrounding the co-benefits of weatherization, such as the health and household related benefits[11]. Eleven percent of the respondents stated they do not want to receive public assistance. Some stated they felt that other people were more in need, while others stated that their reluctance to apply was a matter of pride. Identification of these

[11] See Tonn et al., 2014c. *Health and Household Related Benefits Attributable to the Weatherization Assistance Program.*

specific obstacles provides valuable information in order to better understand these individuals and for re-framing the program if target populations are not being reached. Other obstacles mentioned (e.g., too much paperwork, and not having a vehicle available to apply for WAP services) could be minimized by modifying and streamlining application and intake processes.

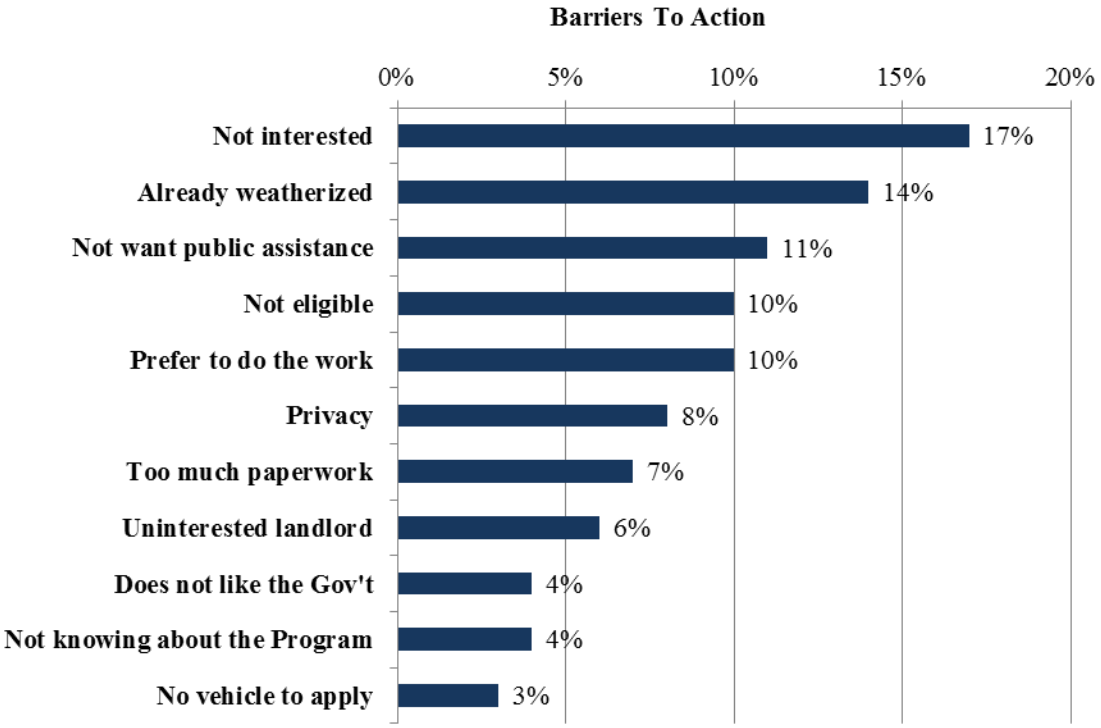

Figure 4.5. Barriers for Not Taking Action (n=255)

5. SOCIAL NETWORK AND NODE VISUALIZATION

Statistical analysis for this study was conducted exclusively with SPSS. However, exploratory data analysis (EDA)[12] was conducted through Gephi[13], an interactive visualization and exploration software platform, to summarize node attributes and network structure, or typology. This type of visualization analysis assist with; (1) identifying central nodes and patterns in relationships or interactions, and (2) assessing which nodes are central to spreading information and their potential degree of influence on the network.

Network Typology

Referring to Figure 5.1, the nodes, or sources of information, are represented by colored circles, and the "edges", or linkages, are represented by lines. In this study, the linkages refer to the flow of weatherization-related information between two nodes. The size of the node is a function of the number of edges that lead out from the node; more specifically, the larger the node the more people, or entities, they shared information with. This is referred to in network analysis[14] as centrality[15]. In the case of a directed network, where information has a directional flow, there are two separate measures of centrality, namely 'in-degree' and 'out-degree' (Scott 2012). The colors of the circles differentiate the nodes based on their categorical attributes, which are partitioned by "type" (i.e. DOE, states, WAP agencies, interviewer, and respondent, round 1 and round 2). In Figure 5.2 directed edges capture this information flowing *back* to the WAP agency when the respondent reported contacting an agency; node size is a function of the out-degree centrality.

Based on the out-degree metric, Figure 5.1 illustrates the traffic volume the agencies received situated as information hubs for states, agency staff, and the WAP eligible population. In this particular graphic, 1299 edges and 871 nodes are displayed, representing the potential for information diffusion just within this exploratory study. Again, this study captures the impact of WAP recipients and staff associated with 10 local weatherization agencies. The diffusion of information generating from all 900+ weatherization agencies and the over one million homes weatherized during ARRA offers the magnitude for true impact. For example, if the 41% of respondents stating they contacted a weatherization provider for more information could be extrapolated to the ~ one million WAP households served during ARRA, then the program could estimate that 410,000 additional households contacted a professional service to help them save energy in their homes after conversations with a WAP recipient or staff within their social networks. However, due to the purposive sample selection and this study being exploratory by nature, these results cannot be generalized across the program. Additionally, further research efforts would need to determine the degree of overlapping between networks to avoid over-estimating the impacts.

[12] John Tukey and Edward Tufte were the thought leaders in the use of exploratory data analysis (EDA) through data visualization. Tukey (1977) promoted EDA stating that in statistics too much emphasis was placed on *confirmatory* data analysis rather than using data to *suggest* hypotheses to test. Tufte is of the opinion that better inferences can be made from statistical graphics (Tufte, 2001).

[13] See Bastian and Heymann, 2009. Gephi, the open-source software is available for download at http://gephi.github.io/

[14] Other SNA metrics involving connections (e.g. homophily, multiplexity, mutuality, propinquity) and segmentations (e.g. clustering coefficient, cohesion) were not calculated due to data acquisition requirements extending beyond the scope of this exploratory study.

[15] Other centrality metrics are (Scott, 2013): closeness (closeness to the entire network), betweenness (bridges nodes), and Eigenvector centrality (connection to well-connected nodes). Again, the data required to calculate these metrics was not collected due to the limited scope of this exploratory study.

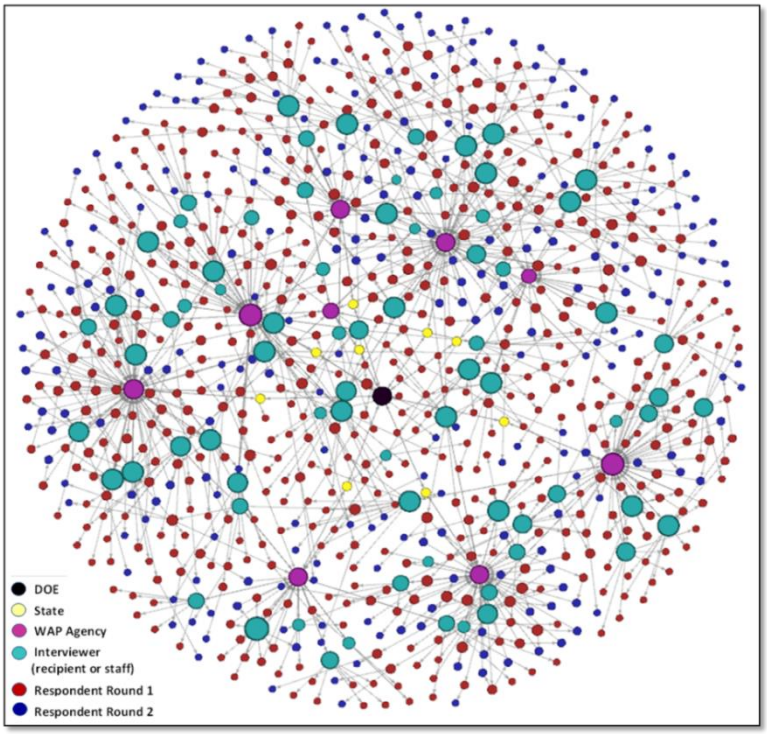

Figure 5.1. Network Typology – Size of Nodes Based On Out-Degree Centrality; Color of Nodes Partitioned By 'Type'

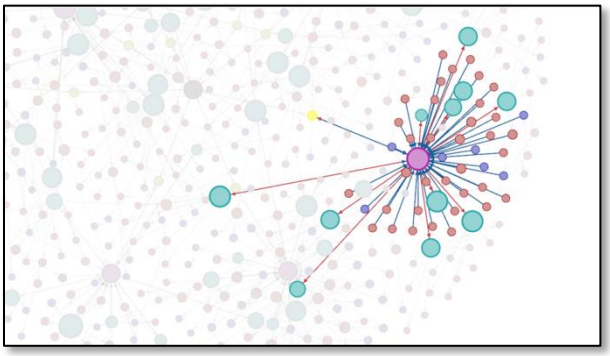

Figure 5.2. Directional Edges Capture Information Flowing Back To Single WAP Agency (Pink Node)

As shown in these visualization exercises, the potential for influence is scaled based on the characteristics and placement of the node within the network. A function within Gephi, the modularity clustering tool, assists with the identification of different modules, or clusters, within the network as a whole. The modularity algorithm looks for nodes that are more densely connected together than to the rest of the network and is used for detecting community structure in networks (i.e. overlapping or non-overlapping). Figure 5.3 illustrates clustering around the agency as key nodes within this seemingly non-overlapping network. Agencies become central hubs for identifying and receiving best practice knowledge for weatherization. Agencies who implement this direct service report back to the state and sometimes federal offices to inform best practice guidelines which flow back down to the agency level, similar to a feedback loop. Agencies then deliver that information and best practice to members within its WAP eligible service territory.

What is not noted here are additional connections WAP agencies, typically CAAs, have beyond this network such as utility companies, and other local, state and federal agencies that develop, fund and deliver other energy programs under the CAA services umbrella such as the US Department of Health and Human Services' (HHS) Low Income Home Energy Assistance Program (LIHEAP).

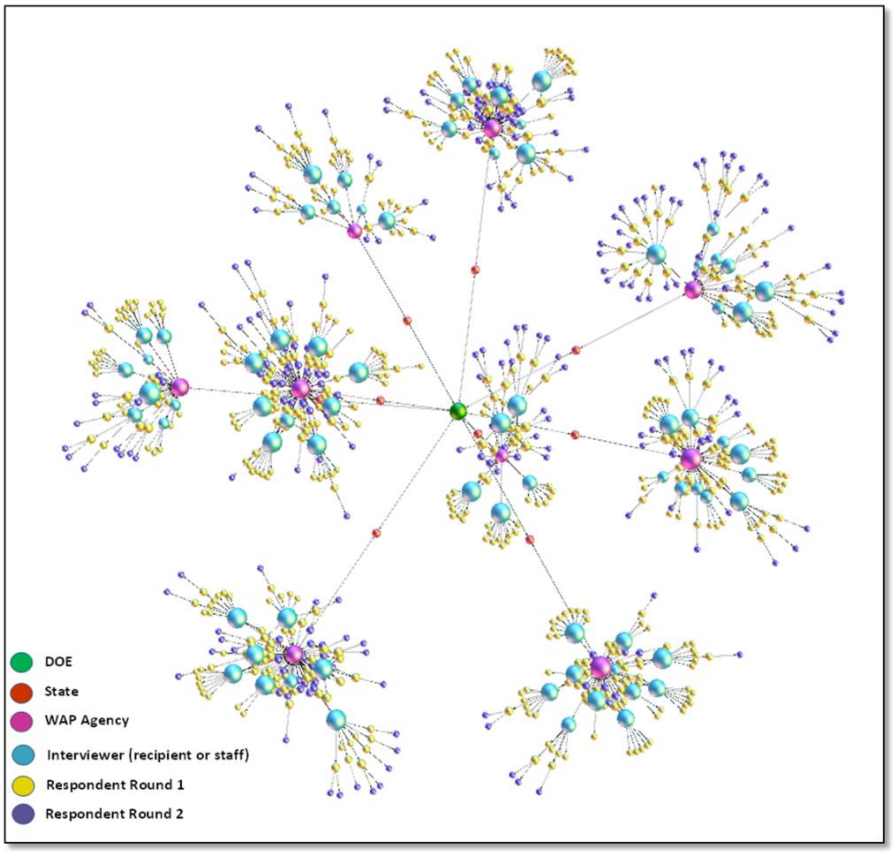

Figure 5.3. Network Clustered By Agency with DOE in the Center (Green) - Size of Nodes Based On 'Out-Degree Centrality' and Color of Nodes Partitioned By 'Type'

Node Attributes

In this next set of images (Figure 5.4, 5.5, 5.6) colors of nodes, for the respondents only, are partitioned by their categorical attributes based on 'action taken'. Note that DOE, the WAP agencies, and trained WAP recipient and staff interviewers are not partitioned but customized to be represented by light pink circles as the initial communicators of weatherization-related information. The remaining colored nodes are the respondents, the members of the social networks potentially impacted by receiving weatherization-related information. In Figure 5.4, the green nodes contacted a WAP agency after hearing about weatherization. In Figure 5.5, the blue nodes are those that contacted a private contractor, and in Figure 5.6, the yellow nodes completed some form of DIY work. The red nodes represent those who did not take that energy saving action. The purpose of this visualization is to first realize that all the nodes, other than the initial light pink nodes, prior to hearing about weatherization were red. Now, due to the communication shared by these initial nodes, the attributes of those nodes has changed. The red became green, blue, or yellow, depending on what home energy conservation action was taken. The initial nodes acted as catalysts for change that might have never come or might have happened at a later time, prolonging the rate of information diffusion into these and extending networks.

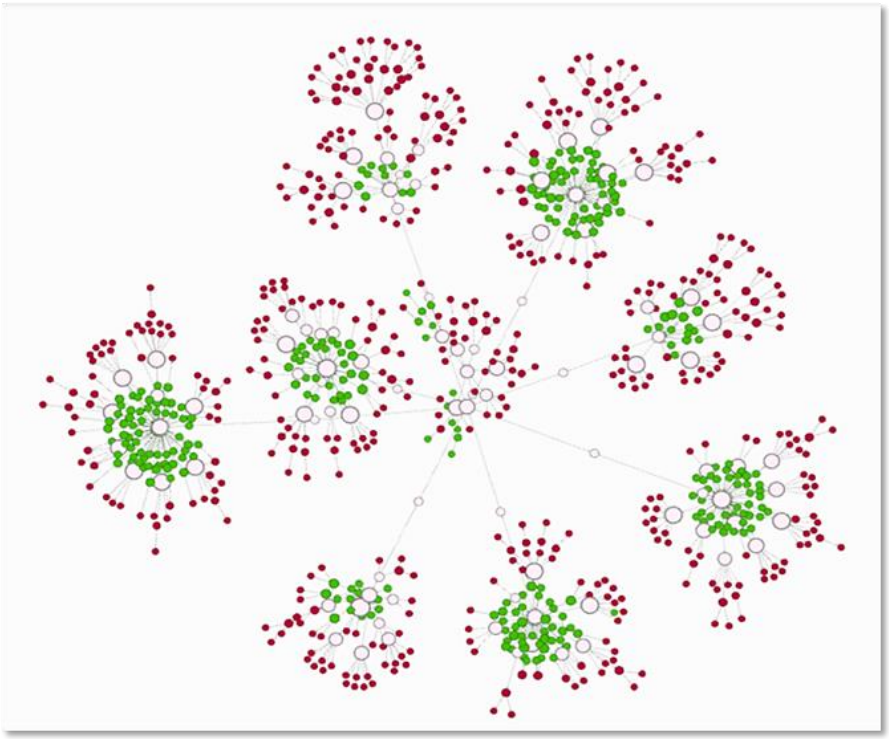

Figure 5.4. Contacted WAP Agency; Green Nodes = Yes

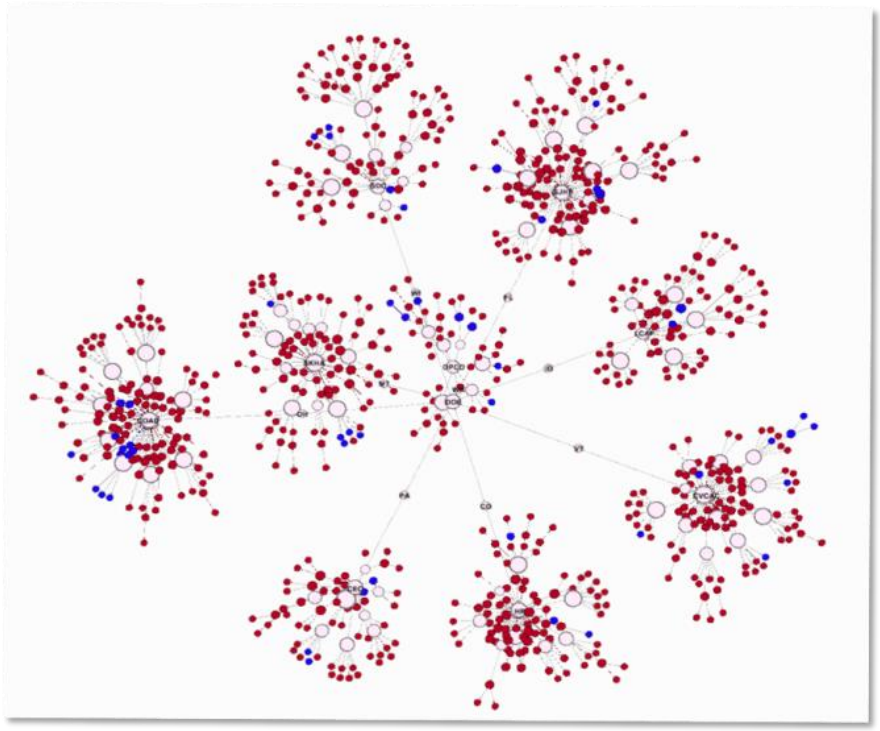

Figure 5.5. Contacted Private Contractor; Blue Nodes = Yes

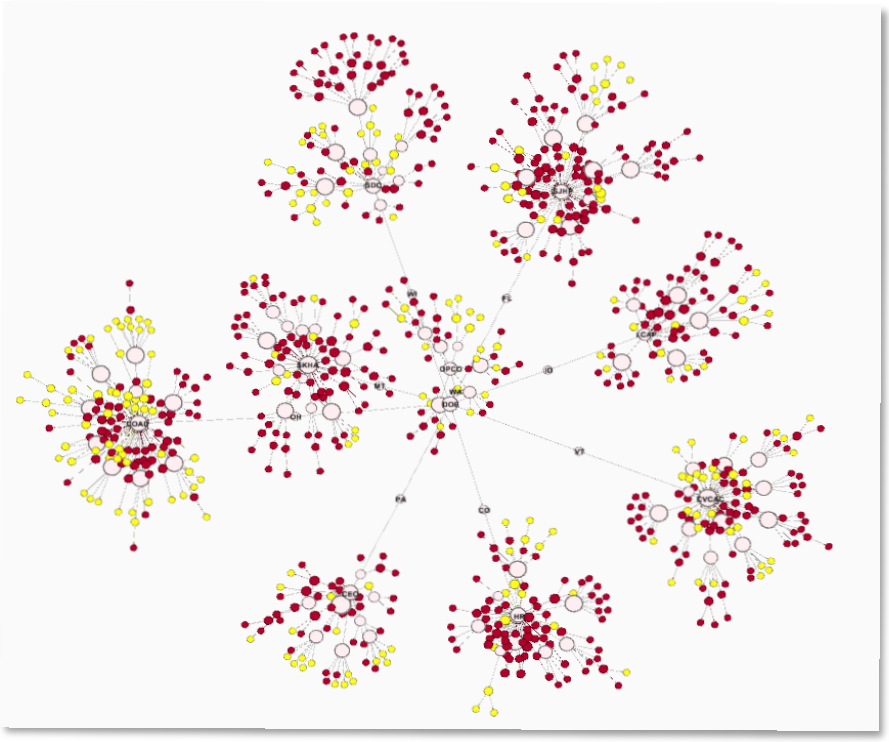

Figure 5.6. DIY Weatherization Measures; Yellow Nodes = Yes

6. CONCLUSION

What we have confirmed through this exploratory study is that experiences with WAP and home energy conservation are shared within social networks. The key finding is that information shared from these personal sources influences the decision making and energy saving action of others for a myriad of reasons. This is consistent with other research suggesting that the sharing of information within networks is the single most effective tactic for propelling the diffusion of innovations (Rogers 2003). A recent study looking at the social context of weatherization services utilization found that that word of mouth communication related to positive experiences with home energy efficiency and weatherization is a predicting variable for others securing weatherization services or activities "over and above the influence of one's energy related knowledge" (Southwell & Murphy 2014).

Dietz (2015) suggests that the argument for taking home energy saving action appeals to households with both self-serving (e.g., reduce utility costs and enhance well-being) and altruistic (environmental conservation) concerns. The WE Project found a statistically significant correlation between those who contacted a private contractor and those reporting being motivated to take action out of concern for the environment. For this group, environmental conservation was the most reported motivating factor. For those who contacted a WAP provider, the top two statistically significant reported motivating factors were "cold winter" and "difficulty paying utility bills." This finding suggests SES might play a role in decision making around home energy efficiency. Being able to identify top motivating factors for contacting a WAP provider or a private contractor is important for marketing home energy conservation programs and for encouraging energy consuming behavior change in the residential sector. Better understanding why households take the action they do provides agencies tasked with reducing energy consumption in this sector necessary information for improving strategies to meet their mission goals. Furthermore, this knowledge contributes to the larger efforts of reducing GHG emissions for the mitigation of anthropogenic induced climate change, eradicating fuel poverty, and for improved public health. For example, Centola (2010) predicts improved outcomes if public health campaigns target clustered residential networks, particularly if the suggested health interventions are highly complex, costly, or challenge existing norms. Weatherization plus Health initiatives provide a local approach for spreading critical energy efficiency and public health information that we now know is indeed shared within social networks.

Utilizing network analysis with a social component as a research technique could prove beneficial when considering how best to communicate other critical messages related to and reliant on human interest and behavior. For example, weatherization contributes to goals for both climate change mitigation and adaptation concurrently. ORNL energy impact analysis and analysis of health benefits attributed to improvements in the IEQ of the dwelling reveals reductions in home energy consumption thereby reducing GHG emissions, and reductions in exposure to extreme temperatures, moisture-related issues, and other hazards (Tonn et al. 2014b). While multi-level climate change action plans are being developed at local, state, regional, national, and global levels, weatherization provides an immediate strategy and has been cited as the top performing home-related method for reducing GHG emissions (Dietz et al. 2009). Further research is needed to better understand these and other potential opportunities at the household level. For example, how do social networks and the key individuals or stakeholders they contain contribute to the adaptive capacity of a community? Can they be used for conducting participatory vulnerability assessments? How can we maximize their potential for improving humanity to the largest scale by contributing to efforts targeting the eradication of preventable disease, or reducing health disparities disproportionately burdening vulnerable populations? Information proven to contribute to energy conservation and other emerging environmental and public health efforts could effectively be packaged and diffused into the social networks of vulnerable populations that often present as closed off to external communication due to cultural or sub-cultural factors. Social network studies can further

assist with mapping transactional relationships between stakeholders, or collaborators involved with interdisciplinary efforts to improve humanity, allowing us better understanding of the flow and strength of their impact as nodes working in concert within these multi-level networks.

REFERENCES

Adams, J. (2010). Exploring links to improve health. *Science, 330,* 1628-1629.

Arsenio, O.I. & Delmas, M.A. (2015). Nonprice incentives and energy conservation. *Proceedings of the National Academy of Sciences, 112(6),* E510-E515

Bastian M., Heymann S., Jacomy M. (2009). Gephi: an open source software for exploring and manipulating networks. International. AAAI Conference on Weblogs and Social Media.

Borgatti, S., Mehra, A., Brass, D. and Labianca, G. (2009). Network analysis in the social science. *Science, 323,* 892-895.

Carroll, D., Berger, J., Miller, C., and Driscoll, C. (2014a). National Weatherization Assistance Program Impact Evaluation - Client Satisfaction Survey: WAP Service Delivery from the Client's Perspective. ORNL/TM-2014/335, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Carroll, D., Berger, J., Miller, C., and Johnson, DB. (2014b). National Weatherization Assistance Program Impact Evaluation: Weatherization Staff Survey. ORNL/TM-2014/323, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Centola, D. (2010). The spread of behavior in an online social network experiment. *Science, 329,* 1194-1197.

Dietz, T. (2015). Altruism, self-interest, and energy consumption. *Proceedings of the National Academy of Sciences, 112*(6), 1654-1655.

Dietz, T., Gardner, G., Gilligan, J., Stern, P. and Vanderbergh, M. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences, 106*(44), 18452-18456.

Orgnet.com. (2014) *Social network analysis, a brief introduction.* Retrieved from; http://orgnet.com/sna.html

Rogers, Everett M. (2003). *Diffusion of Innovations* (5th ed). New York: Free Press. Print.

Southwell, B. and Murphy, J. (2014). Weatherization behavior and social context: The influences of factual knowledge and social interaction. *Energy Research & Social Science, 2,* 59-65.

Scott, John (2013). *Social Network Analysis* (3rd ed). London: SAGE.

Tonn, B., Rose, E., and Hawkins, B. (2014a). Weatherization – Beyond the Numbers: Case Studies of Fifteen High-Performing Weatherization Agencies - Conducted May 2011 – July 2012. ORNL/TM-2014/317, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Tonn et al. (2014b). Weatherization Works – Summary of Findings from the Retrospective Evaluation of the U.S. Department of Energy's Weatherization Assistance Program. ORNL/TM-2014/338, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Tonn, B., Rose, E., Hawkins, B., and Conlon, B. (2014c). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program. ORNL/TM-2014/345, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Tukey, John W. (1977). Exploratory Data Analysis. Pearson. ISBN 978-0201076165.

Tufte, Edward R. (2001). *The Visual Display of Quantitative Information* (2nd ed.). Cheshire, CT: Graphics Press. Print.

APPENDIX A. WHAT DO YOU REMEMBER SAYING?

APPENDIX A. WHAT DO YOU REMEMBER SAYING?

(QUESTIONNAIRE FOR RESEARCHER)

1. Use this form to collect your thoughts about what you remember about the conversations you have had *before* beginning your interviews. Write down what you remember saying, **in general**. If you talked about something unique and different with specific people then please make a note of it on the appropriate interview documentation form. This form should only be filled out once.

Your Initials:	**CONVERSATION DATE (Approximate):**
HOW DID YOU TELL THEM? (phone, email, in-person, other):	
WHAT DID YOU TELL THEM ABOUT? Try to think about specific things you said.	
THE PROGRAM	What did you tell them about the Weatherization Assistance Program?
ENERGY SAVINGS	What did you tell them about how much you saved or think you will save?

WEATHER-IZATION MEASURES	What types of weatherization measures did you talk about?
HEALTH AND SAFETY	Describe any changes in health, safety measures or sense of security that you might have talked about.
COMFORT	What did you tell them about changes in comfort level? (Draftiness, Hot/Cold)

EDUCATION	Did you tell them anything you learned from the weatherization workers about how to save energy? (for example, turning off lights, use of windows, Unplugging TVs, thermostat or hot water heater settings)
OTHER	Did you share anything else? (Worker friendliness, respect for privacy)

APPENDIX B. USE OF SOCIAL MEDIA LIKE FACEBOOK OR TWITTER

APPENDIX B. USE OF SOCIAL MEDIA LIKE FACEBOOK OR TWITTER

(QUESTIONNAIRE FOR RESEARCHER)

Document any online social media communication that you had telling people about energy savings, changes in health of household members, safety and comfort of the home or anything else about the weatherization work done on your home.

Use the Table Below to Document Your Use of Social Media (add pages if necessary)

Social Media	WHAT DID YOU SAY? Go back into your messages and write down exactly what you said.	Number of Followers, Friends, or recipients
Facebook	Your Message:	
Twitter	Your Message:	
Blog	Your Post:	
Other (be specific):	Your Message:	

Counting responses/comments back:

Social Media	WHAT DID THEY SAY? Go back into the social media site and **count** how many responses fit into the following categories:			
	Already had home energy work done prior to your message.	Positive Response but did not report back that they did anything	Applied for WAP	Did something other than WAP as a result of your message (ex. had an energy assessment or work done or installed something new, or changed behaviors and habits)
Facebook				
Twitter				
Blog				
Other:				

Write down one response that someone said if they *did* something *after* you told them about what you had done to your home.

_____

_____

_____

_____

_____

_____

_____

_____

Write down one response that someone said if they had a negative experience or problem with the WAP program

NOTES OR COMMENTS:

APPENDIX C. INTERVIEW GUIDE

APPENDIX C. INTERVIEW GUIDE

PART 1:
INTERVIEW WITH YOUR FRIENDS OR FAMILY

YOUR NAME:_____ DATE:_____

- **WHAT DOES YOUR FRIEND/FAMILY REMEMBER YOU TELLING THEM?**

Read or improvise your opening statement to tell your friend/family why you're calling. Take notes on this documentation forms that we have provided for you. Don't be afraid to pause to take the notes. Simply explain that you are taking notes if there is a long pause.

Find out what they remembered about your conversations about your weatherization experience (or if you are staff and you did not have your house weatherized then just weatherization in general).
When do they remember the conversation taking place?
Ask them if it seemed like weatherization is worth it to you.

Is there someone over the age of 65 or under the age of 5 or someone with a disability living in the home? Over 65? (Y/N): Small Children? (Y/N): Disability (Y/N):
What state does your friend/family live in?

- **WHAT DID YOUR FRIEND DO?**

Get them talking about what they did as a result of learning about weatherization:

Did they contact someone for more information?	**YES/NO**
Local community action agency for weatherization?	
Private service for an audit and/or weatherization or other home energy saving program?	
Go to a hardware store for do-it-yourself weatherization improvements?	
WRITE IN OTHER:	

Did they make any changes at their home or to their behavior AFTER your conversation? (even if they did NOT apply for weatherization at a local agency) (Y/N):	
The following are **examples** of what they may have done: o unplug appliances o turn off lights? o open bedroom door to let heat out o before turning on room air conditioner o clean refrigerator coils o change thermostat settings	**What they did:**

○ change air filter ○ read utility bills ○ perform any weatherization measures on their own	

If they **did not** make contact with a local agency or take steps to apply for weatherization, **SKIP to the "OBSTACLES"** section on page 12. (It is VERY important to document ANY changes they have made, even if they did not get their home weatherized through a local agency.)

If they did make contact, ask where they are in the process. Did they have the audit or assessment done? Do they know what was recommended?
Have they actually had any work completed by the agency? If so, ask what changes were made to their home.

- **WHAT WAS THE BEST/WORST THING?**

Your job is to collect some details about what worked for them and what they didn't like. When changes are made in a person's home, they are often excited and notice improvements, but sometimes they are disturbed by the intrusions, or by having to change their behavior.

Find out if there are things they can do now that they were not able to do before, for example: o able to use more energy to be more comfortable or get more done (e.g., laundry) o pay for things they weren't able to pay for before (their utility bill, rent or mortgage, medicine, food, consumer products, services such as childcare, travel, education, other…)

Have they noticed any changes in frequency of health problems or symptoms? Such as: o shortness of breath o lung irritation or cough o persistent cold symptoms o low energy	
IF NO CHANGE, CHECK HERE	

IF YES, WRITE THEIR STORY:	

Do they feel more comfortable or safer in their home? Get them to talk about changes noticed in: o temperature o draft o dust or mold	
IF NO CHANGE, CHECK HERE	
IF YES WRITE THEIR STORY:	

Now that the weatherization has been done, what is the air like inside the home (comparing before and after)? o More or less dusty? o More or less moldy? o More or less humid? o More or less comfortable?	
IF NO CHANGE, CHECK HERE	
IF CHANGE WRITE THEIR STORY HERE:	

In a general way find out how your friend/family feel about the changes in their home? Get your friend/family to tell stories of things that show the differences.

- **WHY DID YOUR FRIEND/FAMILY GET THEIR HOME WEATHERIZED?**

What reason motivated them to get their home weatherized? o a cold winter o a hot summer o difficulty paying utility bill or other bills o mold inside the home o general health and safety of the home o specific health problems of someone living in the home o the health of the planet, energy conservation
Get your friend/family to tell stories of these reasons. You can rephrase what you have heard from your friend/family. For example you could say: "From what I heard it sounds like the most important reason you got your home weatherized was to help your daughter's asthma. Can you tell me more about that?"

- **VALUES**

Sometimes these reasons help you understand your friend's priorities and values. As you listen ask them for stories and memories to explain these values. Find out which of these reasons is ***most*** *important in your friend/family's values.*

****at this point, you probably have a good idea of what your friend's values are but try to encourage stories***

Circle which one you think best applies:

- saving money
- the environment
- home comfort
- health and safety
- other:_____

- **IDENTIFY POTENTIAL OBSTACLES- WHAT GOT IN THE WAY?**

Find out why the family member or friend took some action(s) but not others (and what would have made these easier) or why they did not do anything at all. They may have talked about this already, but if not here are some examples of common barriers. o just not interested o money is an issue o too busy o saving energy is only for environmentalists o do not have a vehicle o prefer to do it myself o don't want to accept public assistance o don't like the government o too much paperwork o privacy o other: _____
NOTES:

- **HOW WAS IT PAID FOR?**

For those that did weatherization measures on their home but were NOT eligible for financial assistance may have needed additional financing. They may have applied for a loan or had the cost added to their mortgage or their utility bill.

Did they have to finance the weatherization/energy work done on their home?
CIRCLE: YES or NO

If YES, Ask about sources that they may have utilized. Examples: (mark if any of these were used): o If a renter, landlord may have contributed o Bank Loans: ▪ home equity line of credit, ▪ personal loan, ▪ mortgage (part of first mortgage when purchasing the home or second mortgage) o Home energy business loan o General contractor loan o On-bill financing (the cost of the weatherization is paid off as part of the utility bill payment)

- **IN CONCLUSION**

Did they talk to anybody else about weatherization?

CIRCLE: YES or NO

If YES, ask approximately how many? _____

Write up to two names on the color-coded chart provided in your folder. (FOR YOUR RECORDS ONLY- PLEASE DO NOT SEND BACK TO US!!)

Don't forget to say:

Thank you! And to let them know their answers will hopefully help improve programs offered by the Department of Energy.

EXTRA NOTES:

PART II: YOUR FAMILY AND FRIENDS' FAMILY AND FRIENDS

PART II: INTERVIEW WITH ONE PERSON YOUR FAMILY OR FRIEND SPOKE TO ABOUT WEATHERIZATION OR ENERGY SAVINGS

- **PRELIMINARY SCREENING QUESTION**

Read or improvise your opening statement to tell this second round of individuals why you're calling.

YOUR INTRODUCTION TO PEOPLE YOU DO NOT KNOW

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

***Double-check with the individual to confirm that they remember the conversation they had with your friend or family about weatherization and energy-savings or health impacts.**

- **WHAT DO THEY REMEMBER ABOUT THE CONVERSATION?**

Find out what they remembered about the conversation they had with your friend/family about weatherization.

When do they remember the conversation taking place?
Ask them if it seemed like weatherization is worth it to the person they spoke to.
Is there someone over the age of 65 or under the age of 5 or someone with a disability living in the home? Over 65? (Y/N): Small Children? (Y/N): Disability (Y/N):
What state do they live in?

- **WHAT DID THEY DO?**

Get them talking about what they did as a result of learning about weatherization:

Did they contact someone for more information?	**YES/NO**
Local community action agency for weatherization?	
Private service for an audit and/or weatherization or other home energy saving program?	
Go to a hardware store for do-it-yourself weatherization improvements?	
WRITE IN OTHER:	

Did they make any changes at their home or to their behavior AFTER your conversation? (even if they did NOT apply for weatherization at a local agency) (Y/N):	
The following are **examples** of what they may have done:	**What they did:**

○ unplug appliances ○ turn off lights? ○ open bedroom door to let heat out ○ before turning on room air conditioner ○ clean refrigerator coils ○ change thermostat settings ○ change air filter ○ read utility bills ○ perform any weatherization measures on their own	

If they **did not** make contact with a local agency or take steps to apply for weatherization, **SKIP to the "OBSTACLES"** section on page 26. (It is VERY important to document ANY changes they have made, even if they did not get their home weatherized through a local agency.)

If they did make contact, ask where they are in the process. Did they have the audit or assessment done? Do they know what was recommended?

Have they actually had any work completed by the agency? If so, ask what changes were made to their home.

- **WHAT WAS THE BEST/WORST THING?**

Your job is to collect some details about what worked for them and what they didn't like. When changes are made in a person's home, they are often excited and notice improvements, but sometimes they are disturbed by the intrusions, or by having to change their behavior.

Find out if there are things they can do now that they were not able to do before, for example: o able to use more energy to be more comfortable or get more done (e.g., laundry) o pay for things they weren't able to pay for before (their utility bill, rent or mortgage, medicine, food, consumer products, services such as childcare, travel, education, other…)

Have they noticed any changes in frequency of health problems or symptoms? Such as: o shortness of breath o lung irritation or cough o persistent cold symptoms o low energy	
IF NO CHANGE, CHECK HERE	
IF YES, WRITE THEIR STORY:	

Do they feel more comfortable or safer in their home? Get them to talk about changes noticed in: o temperature o draft o dust or mold	
IF NO CHANGE, CHECK HERE	
IF YES WRITE THEIR STORY:	

Now that the weatherization has been done, what is the air like inside the home (comparing before and after)? o More or less dusty? o More or less moldy? o More or less humid? o More or less comfortable?	
IF NO CHANGE, CHECK HERE	
IF CHANGE WRITE THEIR STORY HERE:	

In a general way find out how they feel about the changes in their home? **Get them to tell stories of things that show the differences.**

- **WHY DID THEY GET THEIR HOME WEATHERIZED?**

What reason motivated them to get their home weatherized? o a cold winter o a hot summer o difficulty paying utility bill or other bills o mold inside the home o general health and safety of the home o specific health problems of someone living in the home o the health of the planet, energy conservation
Get them to tell stories of these reasons. You can rephrase what you have heard. For example you could say: "From what I heard it sounds like the most important reason you got your home weatherized was to help your daughter's asthma. Can you tell me more about that?"

- **VALUES**

Sometimes these reasons help you understand an individual's priorities and values. As you listen ask them for stories and memories to explain these values. Find out which of these reasons is ***most*** *important to them.*

****at this point, you probably have a good idea of what their values are but try to encourage stories***

Circle which one you think best applies:

- saving money
- the environment
- home comfort
- health and safety
- other:_____
  ___

- **IDENTIFY POTENTIAL OBSTACLES- WHAT GOT IN THE WAY?**

Find out why they took some action(s) but not others (and what would have made these easier) or why they did not do anything at all. They may have talked about this already, but if not here are some examples of common barriers. o just not interested o money is an issue o too busy o saving energy is only for environmentalists o do not have a vehicle o prefer to do it myself o don't want to accept public assistance o don't like the government o too much paperwork o privacy o other: _____
NOTES:

- **HOW WAS IT PAID FOR?**

For those that did weatherization measures on their home but were NOT eligible for financial assistance may still have needed additional financing. They may have applied for a loan or had the cost added to their mortgage or their utility bill.

Did they have to finance the weatherization/energy work done on their home?
CIRCLE: YES or NO
If YES, Ask about sources that they may have utilized. Examples: (mark if any of these were used): o If a renter, landlord may have contributed o Bank Loans: ▪ home equity line of credit, ▪ personal loan, ▪ mortgage (part of first mortgage when purchasing the home or second mortgage) o Home energy business loan o General contractor loan o On-bill financing (the cost of the weatherization is paid off as part of the utility bill payment)

- **IN CONCLUSION**

Did they talk to anybody else about weatherization?

CIRCLE: YES or NO

If YES, ask approximately how many? _____

Don't forget to say:

Thank you! And let them know their answers will hopefully help improve programs offered by the Department of Energy.