Appendix J - GPRA07 Weatherization and Intergovernmental Activities Program (WIP) Documentation

Introduction

The Weatherization and Intergovernmental Activities Program (WIP) develops, promotes, and accelerates the adoption of energy efficiency, renewable energy and oil displacement technologies and practices by a wide range of stakeholders. These include State and local governments, weatherization agencies, communities, companies, fleet managers, building code officials, Native American Tribal Governments, and international partners. **Table J-1** outlines the activities characterized for WIP for GPRA07. Characterizations and inputs for these activities were provided to the Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE) as inputs to EERE's integrated modeling effort.

Table J-1. WIP Subprograms, Projects, and Activities

Subprogram	Project	Activity
State Energy Program Grants	State Energy Program Grants	Codes and Standards Energy Audits Rating and Labeling Workshops/Training Incentives Retrofits Loans and Grants Technical Assistance Traffic Signals
Weatherization Assistance Program Grants	Weatherization Assistance	Weatherization Assistance
Intergovernmental Activities	Tribal Energy Activities	Tribal Energy Activities
	International Renewable Energy Program	International Renewable Energy Program

1.0 State Energy Program Grants

Project Description. The State Energy Program provides financial assistance to States, enabling State governments to target their own high priority energy needs and expand clean energy choices for their citizens and businesses. With these funds and the resources leveraged by them, the State and Territory Energy Offices develop and manage a variety of programs geared to increase energy efficiency, reduce energy use and costs, develop alternative energy and renewable energy sources, promote environmentally conscious economic development, and reduce reliance on imported oil.

1.1 State Energy Program Grants

1.1.1 Significant Changes from FY06

Inputs for the State Energy Program Grants were updated, based on more recent and more complete information. The FY06 inputs were derived from the 2003 report, *Estimating Energy and Cost Savings and Emissions Reductions for the State Energy Program Based on Enumeration Indicators Data*;[(1)] the updated inputs are based on the 2005 report, *An Evaluation of State Energy Program Accomplishments: 2002 Program Year*.[(2)] For this report, all states and territories were contacted by the SEP program and asked to provide counts of specified SEP activities that were performed during the 2002 program year. All 50 states and four of five territories provided information for activities that used SEP funds. For FY07, the WIP program added a new project area, Traffic Signals, to the analysis.

1.1.2 Target Market

Market Description. The market includes all markets (including buildings, transportation, industry, and power technologies), except new construction and all categories of energy end use.

Baseline Technology Improvements. There are no technology improvements assumed apart from what appears in the Energy Information Administration (EIA) baseline.

1.1.3 Methodology and Calculations

Inputs to Base Case. The WIP program did not provide inputs to change the base case assumptions for the program markets. The WIP program's calculations were based on a baseline that was developed from the Energy Information Administration's (EIA's) Commercial Buildings Energy Consumption Survey (CBECS), Residential Energy Consumption Survey (RECS), and the Annual Energy Outlook (AEO).

Technical Characteristics. For the FY07 GPRA metrics, the State Energy Program (SEP) was characterized based on the budget request and leveraged funds. Based on the report, *An Evaluation of State Energy Program Accomplishments: 2002 Program Year* (Schweitzer and Tonn 2005),[(2)] nine activities (referred to in the report as project areas) supported by SEP were selected to represent the project. These activities—Codes and Standards, Energy Audits, Rating and Labeling, Workshops/Training, Incentives, Retrofits, Loans and Grants, Technical Assistance, and Traffic Signals—comprised approximately 90% of the total estimated energy savings reported.

In previous years, the SEP has administered funds on behalf of other EERE projects, through "Special Projects" funds. The WIP program has assumed that the energy savings resulting from these funds were captured in the originating project (the project that provided the funding). For FY07, funds previously budgeted through Special Project funds became part of SEP. The WIP program assumed that this new funding would be

administered to project areas based on the historical percentages reported in Schweitzer and Tonn. A key assumption in the program's methodology is that benefits are directly proportional to funds expended.

Codes and Standards. The purpose of the SEP Codes and Standards activity is to encourage the adoption of building codes and standards through training and implementation activities. Data was collected on three separate metrics related to building codes: name of new energy-efficiency building code adopted; name of old energy-efficiency building code replaced; and percentage of new construction in state covered by the new code.[2] The information provided by the states on all three metrics combined was used to calculate energy savings achieved by code activity.[2] For consistency, the WIP program based the estimated savings of the Codes and Standards activities funded by the SEP on the savings estimates produced for the Residential and Commercial Energy Codes projects within the Office of Building Technologies (BT). Historically, Codes and Standards activities accounted for almost 19% of SEP funding.[1] Based on the FY 2006 budget request, this would have equated to approximately $7.7 million; with the inclusion of the former Special Projects money (of about $19 million for FY07), the budget for codes and standards would be anticipated to be about $11.3 million, an increase of about $3.6 million. The WIP program assumes that this increase in budget corresponds to an allocation of about 50% of the estimated energy savings for Codes and Standards training/implementation activities.

Energy Audits. The purpose of the SEP Energy Audits activity is to perform energy audits. Energy-audit calculations were based on three indicators: number of audits, square feet retrofit, and reported savings.[2] For this effort, the WIP program converted these three indicators to number of households and square footage of commercial floor space impacted.

The WIP program assumed a savings per audit of 21.7 MMBtu per household and 0.0167 MMBtu per square foot of commercial floor space.[2] The per-unit energy savings estimate for residential retrofits listed in the "An Evaluation of State Energy Program Accomplishments: 2002 Program Year" report (43.3 million source Btu per project) provides the base for the estimate of savings associated with energy audits in the residential sector. An adjustment factor of 0.50 was applied to the retrofit number, based on the conservative assumption that only half of the recommended measures would be installed. Based on Tables 1.2.3 and 1.2.4 of the *Buildings Energy Databook,*[2] approximately 84 MMBtu/HH/yr are used by residential space heating and space cooling, yielding a load reduction attributable to the audits of 26% for residential space heating and cooling. Based on Tables 1.3.3 and 1.3.4 of the *Buildings Energy Databook*, approximately 121 kBtu/SF/yr are used by commercial space heating, space cooling, and lighting, yielding a load reduction attributable to the audits of 14% for commercial space heating, space cooling, and lighting.

States reported to the WIP program a total of 581 residential audits performed, 1,878,809 residential square feet retrofit, and 139,851 MMBtu projected residential source savings. To convert the residential indicators into an estimated number of households, the WIP

program assumed that each residential audit represented one household, divided the total residential square feet retrofit by 1,707, which is the average heated square footage for all residential units in the United States from the *2001 Residential Energy Consumption Survey*, and divided the estimated reported annual savings by the 21.7 MMBtu/HH figure.(2) This yielded an estimate of approximately 8,100 households impacted by energy audits in any given year.

In the categories of commercial, industrial, and institutional, States reported to the WIP program a total of 35 audits performed, 67,976,934 square feet retrofit, and 17,551,878 MMBtu projected source savings. To convert the commercial/industrial/institutional indicators into an estimated commercial square footage, the WIP program assumed that each commercial audit represented one building multiplied by 14,500 square feet, which is the average building size taken from the *1999 Commercial Building Energy Consumption Survey*, used the square footage reported, and divided the estimated annual savings by the 0.0167 MMBtu/SF figure.(2) This yielded an estimate of approximately 1.1 billion square feet impacted by energy audits in any given year, or 1.6% of existing commercial floor space, in each year.

The WIP program assumed that the number of energy audits performed would be in direct proportion to the funds available for energy audits. Therefore, the estimated penetration was adjusted upward by 46% to reflect the additional funds from the Special Projects monies that would be funded through SEP in FY07.

Rating and Labeling. The energy savings in this project area describe the amount of energy saved (statewide) as a result of a state's endorsement of rating and labeling systems for up to 15 different types of energy consuming devices. Because the Energy Star program is the biggest and most successful rating and labeling program operating at this time, and many states use SEP funds to encourage participation in the Energy Star program, savings associated with the Energy Star program were used to represent the savings achieved by all state rating and labeling efforts. The difference in annual energy use between an Energy Star unit and a typical unit for each type of device was identified.(2) The national savings for each type of energy-consuming device was adjusted downward by multiplying by an "attribution factor" of 0.10, which approximates the proportion of Energy Star purchases made as a result of state encouragement.(6) **Table J-2** contains the estimated energy savings from rating and labeling.

Table J-2. Estimated Energy Savings from Rating and Labeling[2]

Device	Energy Star savings per unit (MMBtu source)	Number of Energy Star units sold in U.S., 2002	National Savings, 2002 (MMBtu source)	Adjusted national savings (using 0.10 "attribution factors" (MMBtu source)
Office Computer/Monitor	2.938	22,941,000	67,400,658	6,740,066
Home Computer/Monitor	0.853	11,402,000	9,725,906	972,591
Fax Machine	1.801	2,271,000	4,090,071	409,007
Copier	3.033	209,000	633,897	63,390
Multi-function Device	6.540	1,338,000	8,750,520	875,052
Scanner	2.654	6,810,000	18,073,740	1,807,374
Printer	2.085	7,369,000	15,364,365	1,536,437
TV	0.360	10,446,000	3,760,560	376,056
VCR	0.171	12,028,000	2,056,788	205,679
TV/VCR	0.332	4,643,000	1,541,476	154,148
Audio Equipment	0.171	3,687,000	630,477	63,048
Room AC	0.663	2,195,000	1,455,285	145,529
Dishwasher	0.569	2,262,000	1,287,078	128,708
Refrigerator	1.137	1,956,000	2,223,972	222,397
Clothes Washer	2.464	1,224,000	3,015,936	301,594
Average Savings per Device				933,405

The WIP program used a national per-device estimate for rating and labeling of approximately 933,400 MMBtu per year.[2] While Schweitzer and Tonn allocated these savings to states (based on population) to determine an estimate of savings for states reporting estimates, the WIP program allocated the device savings equally across all states, because no forecast is available for determining which states would fund rating and labeling projects in the future. The equivalent savings per state is about 18,670 MMBtu per device (the national estimate divided by 50).

In 2002, seven states were promoting Energy Star; and 15 widely used energy-consuming devices were characterized in terms of their energy savings.[2] While data underlying the Schweitzer and Tonn report indicate that the seven states make up an average of only 7.7% of sales of the profiled devices, the Energy Star Web site states that more than 40 devices are labeled. There is no forecast available as to which of these 40 devices would be promoted as a result of a state's endorsement of rating and labeling systems, Therefore, while savings per device (for states participating in 2002) are overstated using the averaging methodology that the WIP program used, potential savings from the other 25 labeled devices are not included. The WIP program assumed that the average energy savings are therefore representative of the total potential rating/labeling package. To reflect the additional funds from the Special Projects monies that would be funded through SEP in FY07, the WIP program assumed that 10 states (instead of the reported seven) would provide rating and labeling support in any given year, covering a total of 150 devices (10 × 15). The WIP program assumed that the savings would be effective for 15 years, and that they were attributable to electricity.

Workshops/Training. The purpose of this SEP activity is to promote energy-efficiency measures through workshops and training. The approach to developing a residential sector energy-savings multiplier was to select a package of four common energy-conservation measures that could easily be taught in workshops and training sessions. Consequently, the WIP program modeled the residential training measures as air infiltration sealing, resetting water heater thermostats, attic insulation, and CFLs; and assumed that the average annual savings per household for these four measures was 28.7 source MMBtu, which was derived from the impacts of these measures in four representative cities (Schenectady, New York; Birmingham, Alabama; Moline, Illinois; and Eureka, California) using the *Home Energy Saver* System,[a] a Web-based energy audit system, which is driven by the DOE-2 building simulation program. [2] The WIP program assumed that 3.4 MMBtu of those savings resulted from CFLs; 5.5 MMBtu resulted from resetting water heater thermostats; and that the rest was attributable to space conditioning. [5] Based on the *Building Energy Databook*, [3] Tables 1.2.4 and 1.2.3, total primary household consumption for 2005 is 191.4 MMBtu/HH: 44.1% (or 84.4 MMBtu) is space conditioning, 12.7% (or 24.3 MMBtu) is water heating, and 11.8% (or 22.6 MMBtu) is lighting. Therefore, the estimated savings resulting from residential workshops and training are 23.4% space-conditioning savings, 22.6% water heating savings, and 15% lighting savings. The WIP program assumed that 20% of attendees would implement the measures, based on the findings from three recent studies, [7, 8, 9] and that the average attendee would influence 1.75 homes based on U.S Census Bureau residential construction numbers and conservative estimates formulated in the Schweitzer and Tonn report. [2] There were approximately 49,000 residential workshop attendees in 2002, [2] so the WIP program assumed that this number would continue, resulting in residential workshops/training impacting approximately 17,150 existing residential households, or 0.02% of existing residential homes per year.

Schweitzer and Tonn provided an estimate for both commercial and institutional buildings. Because the savings coefficients reported for commercial (156.8 MMBtu/attendee) and institutional (151 MMBtu/attendee) were within 5% of each other, the two were modeled together by the WIP program. The WIP program assumed estimated commercial savings of 5.25% for HVAC measures and 3.2% for lighting measures based on two reports[10, 11] that identified the percent energy savings possible from HVAC and lighting retrofits in large and small office buildings. [2] Because the buildings evaluated in those reports were selected for their unusually high savings opportunities, the reported savings were divided in half to better represent the potential savings achievable in more typical office buildings, and were then further adjusted by multiplying by an installation rate of 0.20 to reflect the finding noted above, that roughly 20% of workshop attendees implement the measures. The WIP program assumed that HVAC savings equate to both space heating and space cooling. The WIP program used a weighted median number of buildings influenced by each trainee as four buildings per trainee[b]. The total number of attendees in 2002 that had training for commercial

[a] Accessible at http://hes.lbl.gov/

[b] U.S. Census Bureau 1997 indicates that the average residential construction firm builds an average of eight new homes per year. Schweitzer and Tonn applied the conservative assumption that a residential retrofitter will work on approximately 50% of the mean number of homes constructed annually by firms engaged in new construction

buildings was 19,000 and institutional was 25,000. [2] This is equivalent to 176,000 buildings impacted. The WIP program assumed the average square feet per commercial building is 14,500, based on the *1999 Commercial Buildings Energy Consumption Survey*,[2] so commercial and institutional workshops/training impacts about 0.51 billion square feet of existing commercial floorspace, or 0.74% of existing commercial floorspace per year.

The WIP program assumed that the number of workshops/training sessions performed would be in direct proportion to the funds available for workshops and training. Therefore, the estimated penetration was adjusted upward by 46% to reflect the additional funds from the Special Projects monies that would be funded through SEP in FY07.

Technical Assistance. The WIP program assumed that technical assistance is credited with half the implementation of workshops, and half the savings achieved by workshop attendees (see discussion above for derivation of savings estimates). [2] Because the WIP program assumed that technical assistance savings were half the savings of workshops, [2] the estimated savings resulting from residential technical assistance are 11.7% space-conditioning savings, 11.3% water heating savings, and 7.5% lighting savings. The WIP program assumed that 10% of attendees would implement the measures. [2] This implementation rate is half that of the rate used for workshops and training, based on the assumption that the implementation rate would be substantially lower than workshops and training sessions because technical assistance is less intensive and personal interaction is more limited, providing less detailed instruction, and would therefore be expected to be less motivational. There were approximately 297,350 contacts for residential technical assistance in 2002, [2] so residential technical assistance impacts approximately 29,735 existing residential households, or 0.04% of existing residential homes per year.

Because the WIP program assumed that technical-assistance commercial building savings would be half the savings of workshops, [2] this yielded estimated savings of 2.63% in space conditioning and 1.6% in lighting. The WIP program assumed that HVAC savings equate to both space heating and space cooling. The WIP program assumed that 10% of attendees would implement the measures. [2] The total number of technical assistance contacts in 2002 for commercial buildings was 67,000. [2] The WIP program assumed the average square feet per commercial building is 14,500, from the *1999 Commercial Buildings Energy Consumption Survey*, [2] so commercial and institutional workshops/training impacts about 0.19 billion square feet of existing commercial floorspace, or 0.28% of existing commercial floorspace per year.

The WIP program assumed that the amount of technical assistance provided would be in direct proportion to the funds available for technical assistance. Therefore, the estimated penetration was adjusted upward by 46% to reflect the additional funds from the Special Projects monies that would be funded through SEP in FY07.

Financial Incentives. The purpose of this SEP activity is to provide financial incentives (or rebates) to encourage the installation of energy-efficient equipment. Defensible study results were cited on rebate payments and the associated energy savings for four programs: Anaheim Public Utilities Energy Efficiency Incentives Program, Pacific Gas and Electric (PG&E) Single Family Homes Energy Efficiency Rebate Program, Pacific Gas and Electric Multifamily Energy Efficiency Rebate Program, and Pacific Gas and Electric Express Efficiency Program.(2) These program results provide the basis for assumptions made by sector. The WIP program assumed the estimates of savings per rebate dollar by sector as reported in **Table J-3**. (2) The residential sector estimate is a simple average of the Anaheim, PG&E Single Family, and PG&E Multifamily programs. The commercial-, industrial-, and institutional-sector estimates are a simple average of the Anaheim and PG&E Express Efficiency programs. The agricultural-sector estimate was taken from the PG&E Express Efficiency program.

In 2002, incentive funding of $34.7 million ($0.56 million of SEP funds and $34.1 million in leveraged funds) provided for $21.5 million worth of rebates. (2) The WIP program therefore assumed that SEP leverages $60.87 for each program dollar, and that each dollar of total funding provides $0.62 in rebates. Incentive funding as a percent of total SEP funding reported for all project areas was 1.3% in 2002. (2) The WIP program assumed that this percentage would apply to FY07. The WIP program assumed that leveraged dollars per SEP dollar for incentives was $60.87. (2) Based on the FY 2007 request, the WIP program assumed that approximately $48.2 million dollars (from both SEP and leveraged funds) would be spent on incentive activities, equating to about $29.9 million in rebates. Using the rebate dollar amounts by sector from Schweitzer and Tonn's underlying data, the percentage of the total rebate package per sector was calculated (see **Table J-3**) to determine the proportion of each sector's savings, yielding a total annual savings of about 1.6 TBtu [(78.6% x $29.9M x 0.0281) + (14.9% x $29.9M x 0.1558) + (3.1% x $29.9M x 0.1558) + (2.8% x $29.9M x 0.1558) + (0.5% x $29.9M x 0.1455)]. The WIP program assumed that the savings would be in effect for 15 years.

Table J-3. Percentage of Total Rebate Amount and Savings per Rebate Dollar by Sector

	Residential	Commercial	Industrial	Institutional	Agriculture
% of rebate	78.6%	14.9%	3.1%	2.8%	0.5%
MMBtu/$ rebate	0.0281	0.1558	0.1558	0.1558	0.1455

Retrofits. Energy-savings estimates for retrofits were reported in residential and commercial structures, schools, health-care facilities, government buildings, and industrial applications.(2) Retrofit calculations were based on two indicators: number of retrofits and square feet retrofit. (2) For this effort, the WIP program converted these two indicators to number of households and square feet of commercial floor space impacted.

The WIP program assumed a savings per retrofit of 43.4 MMBtu per household based on an unweighted, nationwide average energy savings for the residential sector. This number was based on primary energy savings per house from residential retrofits for four regions of the country, as developed for the Weatherization Assistance Program.[5] The WIP program assumed a savings per retrofit of 18.8% per square foot of commercial floor space. This number was based on the average savings in retrofits in commercial buildings reported in two studies.[12, 13] The WIP program also applied the commercial number to schools and hospitals.[2] Based on Tables 1.2.3 and 1.2.4 of the *Buildings Energy Databook,* approximately 84 MMBtu/HH/yr are used by residential space heating and space cooling, yielding a load reduction of 54% for residential space heating and cooling. The WIP program applied the 18.8% savings to commercial space heating, space cooling, and lighting.

States reported to the WIP program a total of 683 residential building retrofits and 49.7 million square feet of residential floor-space retrofit. To convert the residential indicators into an estimated number of households, the WIP program assumed that each residential retrofit represented one household, and divided the total residential square feet retrofit by the average square feet per household (1,707, which is the average heated square footage for all residential units in the United States from the *2001 Residential Energy Consumption Survey*). This yielded an estimate of approximately 29,800 households impacted by retrofits in any given year, or 0.067% of existing residential single-family buildings in each year.

States reported to the WIP program a total of 92 commercial/industrial/institutional building retrofits and 206.8 million square feet of commercial/industrial/institutional floor-space retrofit. To convert the indicators into an estimated commercial square footage, the WIP program assumed that each commercial retrofit represented one building multiplied by the average building size (14,500 square feet, from the *1999 Commercial Buildings Energy Consumption Survey*) and used the square footage reported. This yielded an estimate of approximately 0.021 billion square feet impacted by retrofits in any given year, or 0.302% of existing commercial floor space in each year.

The WIP program assumed that the number of retrofits performed would be in direct proportion to the funds available for retrofits. Therefore, the estimated penetration was adjusted upward by 46% to reflect the additional funds from the Special Projects monies that would be funded through SEP in FY07.

Loans and Grants. The WIP program found defensible study results on the amount of loans provided and estimated energy savings associated with those loans for the following three programs: Oregon Low-Interest Loan Program, Texas LoanStar Program, and Nebraska Dollar and Energy Savings Loan Program.[2] The WIP program also found defensible study results on the amount of grants provided and energy savings associated with those grants for the following five programs: Illinois Energy Efficient Affordable Housing Program, California Grants, Louisiana Institutional Conservation Program, Wisconsin Farm Save Energy Project, and New York State Variable Speed Drive

Program.[2] The WIP program assumed the estimates of savings per loan/grant by sector, as reported in **Table J-4**. [2] Because the estimates of savings resulting from loans are more conservative than the estimates of savings from grants, the savings from loans were used to represent the total loan and grant activity. The residential-sector estimate is a simple average of the Oregon and Nebraska programs. The commercial-sector estimate is a simple average of the Oregon, Texas, and Nebraska programs. The industrial-, and institutional-sector estimates are a simple average of the Oregon and Texas programs. The agricultural-sector estimate was based on the an average of the Wisconsin Farm Save Energy Project and New York State Variable Speed Drive Program, adjusted by the average ratio of loan to grant coefficients in all other sectors.

Loan/grant funding as a percent of total SEP funding reported for all project areas was 16.2% in 2002. [2] The WIP program assumed that this percentage would apply to FY07. In 2002, leveraged dollars per SEP dollar for loans/grants was $10.65. [2] Based on the FY 2007 request, the WIP program assumed that approximately $113.2 million dollars (from both SEP and leveraged funds) would be spent on loan/grant activities. Using the loan/grant dollar amounts by sector from Schweitzer and Tonn's underlying data, the percentage of the total loan/grant package per sector was calculated (see **Table J-4**) to determine the proportion of each sector's savings, yielding a total annual savings of about 1.9 TBtu [(22.9% x $113.2M x 0.0148) + (9.1% x $113.2M x 0.0148) + (3.4% x $113.2M x 0.0178) + (63.3% x $113.2M x 0.0178) + (1.2% x $113.2M x 0.0161)]. The WIP program assumed that the savings would be in effect for 15 years.

Table J-4. Percentage of Total Loan/Grant Amount and Savings per Loan/Grant Dollar by Sector

	Residential	Commercial	Industrial	Institutional	Agriculture
% of loan	22.9%	9.1%	3.4%	63.3%	1.2%
MMBtu/$ loan	0.0148	0.0148	0.0178	0.0178	0.0161

Traffic Signals. The WIP program assumed that incandescent bulbs used in traffic signals would be replaced with LEDs. [2] The average traffic light serviced would save 793.9 kWh or 8.64 million source Btu per year, and the total number of traffic signals replaced in 2002 was 94,824. [2] The WIP program assumed that this number would be replaced in FY07. The WIP program also assumed that the savings would be in effect for 15 years.

The WIP program assumed that the number of traffic signals replaced would be in direct proportion to the funds available for signal replacement. Therefore, the estimated penetration was adjusted upward by 46% to reflect the additional funds from the Special Projects monies that would be funded through SEP in FY07.

1.1.4 Sources

(1) Schweitzer, M., D.W. Jones, L.G. Berry, and B.E. Tonn. 2003. *Estimating Energy and Cost Savings and Emissions Reductions for the State Energy Program Based on Enumeration Indicators Data*. ORNL/CON-487, Oak Ridge National Laboratory, Oak Ridge, TN.

(2) Schweitzer, M, and B. Tonn. June 2005. *An Evaluation of State Energy Program Accomplishments: 2002 Program Year.* ORNL/CON-492, Oak Ridge National Laboratory, Oak Ridge, TN.

(3) *2005 Buildings Energy Databook*. http://www.buildingsdatabook.eren.doe.gov.

(4) Elliott, D.B., D.M. Anderson, D.B. Belzer, K.A. Cort, J.A. Dirks, D.J. Hostick. 2004. *Methodological Framework for Analysis of Buildings-Related Programs: The GPRA Metrics Effort*. PNNL-14697. Pacific Northwest National Laboratory, Richland, Washington.

(5) Schweitzer, M. and J.F. Eisenberg. 2002. *Meeting The Challenge: The Prospect of Achieving 30 Percent Energy Savings Through the Weatherization Assistance Program*. ORNL/CON 479, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

(6) Feldman, S. and B. Tannenbaum, 2000. "Swoosh!? Awareness and Effects of the Energy Star Brand in Wisconsin Appliance Efficiency Programs," *ACEEE Summer Study 2000*, 6.107-119, American Council for an Energy-Efficient Economy, Washington, DC.

(7) Reed, J.M., M. O'Drain, and J. Chace, 1999. "Transforming Markets Through Educational Information: A Study of the Pacific Energy Center," *1999 International Energy Program Evaluation Conference*, Denver, CO, August 18-20.

(8) Peters, J.S. and M.R. McRae, 2001. *Market Progress Evaluation Report, Architecture + Energy Program, Final Report*, Report #E01-084, Northwest Energy Efficiency Allowance, Portland, Oregon, June.

(9) Tools of Change, 2004. *Whitney Public School Case Study*, www.toolsofchange.com

(10) McClain, H., S. Leigh, and J. McDonald, 1994. *Analysis of Savings Due to Multiple Energy Retrofits in a Large Office Building*, ORNL/CON-363, Oak Ridge National Laboratory, Oak Ridge, TN, May.

(11) Abraham, M. and J. MacDonald, 1995. *Energy and Conservation Opportunities in Small Commercial Buildings*, ORNL/CON-414, Oak Ridge National Laboratory, Oak Ridge, TN, August.

(12) Greely, K., J. Harris, and A. Hatcher, 1990. "Measured Energy Savings and Cost-Effectiveness of Conservation Retrofits in Commercial Buildings," *ACEEE 1990 Summer Study on Energy Efficiency in Buildings*, American Council for an Energy-Efficient Economy, Washington, DC.

(13) Coates, B., 1995. "Persistence of Energy Savings in Commercial Buildings," *1995 Energy Program Evaluation Conference*, 649-655, Chicago, IL.

2.0 Weatherization Assistance Grants

Project Description. The Weatherization Assistance Project provides cost-effective energy-efficiency services to low-income households that otherwise could not afford the investment, but would benefit significantly from the cost savings of energy efficiency technologies. The project focuses on households that spend a disproportionate amount of their income for energy, giving priority to households with elderly members, persons with disabilities, and children.

Weatherization Assistance provides technical assistance and formula grants to State and local weatherization agencies throughout the United States. A network of approximately 970 local agencies provide trained crews to perform weatherization services for eligible low-income households in single-family homes, multifamily dwellings, and mobile homes. Of the homes weatherized annually, 49% are occupied by an elderly person with special needs. or a person with disabilities. All homes receive a comprehensive energy audit, which is a computerized assessment of a home's energy use and an analysis of which energy-conservation measures are best for the home—and a combination of those energy-saving measures are installed.

2.1 Weatherization Assistance

2.1.1 Significant changes from FY06

No significant changes were made to this program for the FY07 effort.

2.1.2 Target Market

Market Description. The market includes households that are eligible for Federal assistance. Households are categorized as eligible for federal assistance if the household income is below the federal maximum standard of 150% of the poverty line or 60% of Statewide median income, whichever is higher. Individual States can also set the standard at a lower level than the federal maximum.[c] Target measures include air sealing; caulking and weather stripping; furnace and boiler tune-up, repair, and replacement; cooling system tune-up and repair; replacement of windows and doors; addition of storm windows and doors; insulation of building shells; and replacement of air conditioners, whole-house fans, evaporative coolers, screening, and window films.(2) Weatherization *Plus* expands this strategy to include water heating, refrigeration, lighting, and cooling.(1)

Size of Market. About 34 million eligible low-income homes are included in the market.

Baseline Technology Improvements. There are no technology improvements assumed apart from what appears in the Energy Information Administration (EIA) baseline.

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c Eligibility requirements for Weatherization Assistance can be found at http://www.eere.energy.gov/weatherization/apply.html

2.1.3 Key Factors in Shaping Market Adoption of EERE Technologies

Price. The WIP program employed the average household weatherization cost of $1,830;[6] this estimate does not include training, technical assistance, and administrative costs. Incremental investment beyond this amount for Weatherization *Plus* homes, estimated at an average of $1,400 by the Weatherization project,[6] was assumed by the Weatherization Assistance Program to be provided by leveraging funds from other organizations. **Table J-5** shows the estimated total costs by region for *Plus* homes.

Table J-5. Estimated Regional Costs for Weatherization *Plus* Homes

Region	Cost per "*Plus*"Household
South	$2861
Northeast	$3674
West	$1814
Midwest	$3429

2.1.4 Methodology and Calculations

Inputs to Base Case. The WIP program did not provide inputs to change the base case assumptions for the program markets. The WIP program's calculations were based on a baseline that was developed from the Energy Information Administration's (EIA's) Commercial Buildings Energy Consumption Survey (CBECS), Residential Energy Consumption Survey (RECS), and the *Annual Energy Outlook* (AEO). For more information about the methodology used by the WIP program, see *Methodological Framework for Analysis of Buildings-Related Programs: The GPRA Metrics Effort* (2004)[7].

Technical Characteristics. This project was characterized based on an estimated level of savings per household, cost to weatherize each household, budget request, leveraged funds, and an assumed life expectancy of 15 years for weatherization measures. The basic assumptions were derived from a spreadsheet provided by the Weatherization project in September 2001.[6]

Table J-6 shows the savings per household used for each region.

Table J-6. Savings Per Household for the Weatherization Assistance Project

Region	Regular Household Savings (MMBtu/yr)	*"Plus"* Household Savings (MMBtu/yr)
South	22.25	24.23
Northeast	31.20	46.04
West	19.04	20.31
Midwest	31.20	49.21

The figures in the table were calculated based on the 1997 ORNL meta-evaluation report,[2] the ORNL *Meeting the Challenge* report,[3] and special tabulations from the 1997 "Residential Energy Consumption Survey."[4]

Of the units weatherized in FY 2007, nearly 50% were assumed by the Weatherization Project[3] to have the higher savings rates associated with Weatherization *Plus*. In the *Meeting The Challenge* report,[3] these savings rates were calculated on a regional basis and multiplied by the expected number of *Plus* households in each region.

To develop energy savings by building type, the WIP program evaluated historical Weatherization project data in the 1997 ORNL report[2] concerning the types of households weatherized (see **Table J-7**).

Table J-7. Percent of Weatherized Households by Type

Household Type	% of Weatherized Households
Single Family	64.0%
Mobile Home	20.0%
Multi Family	16.0%

To develop energy savings by fuel type, the WIP program also used the historical primary fuel Weatherization project data in the 1997 ORNL report.[2] Because the GPRA metrics are reported for electricity, natural gas, and fuel oil (but not for LPG and kerosene), other fuels were allocated within those types based on similarities of emissions. **Table J-8** shows the allocation approaches used.

Table J-8. Percent of Weatherized Households by Fuel Type

Primary Heating Fuel	% of Weatherized Households	Categorized As
Natural Gas	50.6	Natural Gas
Liquid Propane Gas	13.2	
Fuel Oil	16.0	Fuel Oil
Kerosene	3.2	
Other (includes wood and coal)	7.5	
Electricity	9.5	Electricity

The Department of Energy (DOE) budget and leveraged funding forecasts were used to determine the number of households weatherized in each category (regular or *Plus*) for each of the four regions (South, Northeast, West, and Midwest) based on the weatherization costs per household and assumptions regarding the use of leveraged funds. **Table J-9** shows the projection for regular and *Plus* households to be weatherized. The WIP program assumed that the number of households weatherized for each category would be constant from 2011 through 2030.

Table J-9. Projected Regular and *Plus* Households to be Weatherized

	2007	2008	2009	2010	2011
Total Households	188,286	186,942	185,618	184,267	182,983
Regular South	18,907	18,758	18,610	18,460	18,318
Regular Northeast	22,524	22,355	22,189	22,020	21,860
Regular West	24,758	24,661	24,567	24,470	24,378
Regular Midwest	27,955	27,697	27,442	27,183	26,936
Plus South	18,907	18,758	18,610	18,460	18,318
Plus Northeast	22,524	22,355	22,189	22,020	21,860
Plus West	24,758	24,661	24,567	24,470	24,378
Plus Midwest	27,955	27,697	27,442	27,183	26,936

The number of households in each category was multiplied by the estimated savings level for each category. The estimated savings level for each household category was further divided by household type and then by fuel type. The WIP program assumed that savings from each household weatherized would last for 15 years; i.e. savings from households weatherized in 2007 were included in the annual total savings estimates for the years 2007 through 2021.

2.1.5 Sources

(1) *Weatherization Plus: Opportunities for the 21st Century, April 1999, Millennium Committee Strategy Report* accessed at http://www.eere.energy.gov/weatherization/pdfs/mcsr.pdf

(2) Berry, L.G., M.A. Brown, and L.F. Kinney. 1997. *Progress Report of the National Weatherization Assistance Program*, ORNL/CON-450, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

(3) Schweitzer, M. and J.F. Eisenberg. 2000. *Meeting The Challenge: The Prospect of Achieving 30 Percent Energy Savings Through the Weatherization Assistance Program*. ORNL/CON 479, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

(4) Eisenberg, J.F., Oak Ridge National Laboratory. 2001. Special tabulations for the Weatherization Population derived from the 1997 Residential Energy Consumption Survey.

(5) Brown, M.A., L.G. Bery, R.A. Balzer, and E. Faby. 1993. *National Impacts of the Weatherization Assistance Program in Single-Family and Small Multifamily Dwellings*. ORNL/CON-326, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

(6) Eisenberg, J.F., Oak Ridge National Laboratory. 2001. Projections for the Weatherization Assistance Program, provided to the WIP program in file "Projections02d230.xls."

(7) Elliott, D.B., D.M. Anderson, D.B. Belzer, K.A. Cort, J.A. Dirks, D.J. Hostick. 2004. *Methodological Framework for Analysis of Buildings-Related Programs: The GPRA Metrics Effort*. PNNL-14697. Pacific Northwest National Laboratory, Richland, Washington.

3.0 Intergovernmental Activities

The Intergovernmental Activities promote the market transfer of clean energy innovations for sustainable development, trade, security, environment, and climate.

3.1 Tribal Energy Activities

Tribal Energy Activities builds partnerships with Tribal governments to help assess Native American energy needs for residential, commercial, and industrial uses. Additionally, it provides technical and financial assistance in energy efficiency and renewable energy project development. Energy projects are competitively awarded on a cost-shard basis for Native American Tribes to implement comprehensive energy plans.

3.1.1 Significant changes from FY06

This program was not modeled for GPRA benefits prior to the FY07 budget. The WIP program has not characterized this program in the past, because when viewed in the context of national-level energy supply or consumption, the Tribal Energy Program (TEP) would not be expected to either generate or save an amount of energy that would appear in the significant digits of a national number. However, for the sake of completeness, the WIP program characterized this program for the FY07 budget.

3.1.2 Target Market

Target market description. DOE provides enabling funding for tribes to conduct renewables feasibility studies and energy plans, which may lead to actual supply development projects—also funded in part by DOE. The program has the goal of 1 GW of renewables capacity development in Indian Country by 2012 (TEP 2004). The program also funds the development of off-grid solar electrification of reservation households.

Baseline technology improvements. The stated (TEP 2005a) goal of the program is to promote tribal energy sufficiency, economic development and employment on tribal lands through the use of renewable energy and energy efficiency technologies. The TEP offers financial and technical assistance to tribes through government-to-government partnerships that:

1) Allow tribal leaders to make informed decisions;
2) Bring renewable energy and energy efficiency options to Indian Country;
3) Enhance human capacity through education and training;
4) Improve local tribal economies and the environment; and
5) Make a difference in the quality of life of Native Americans.

The program seeks to increase development of renewable energy supply. In 2003, the National Renewable Energy Laboratory (NREL) collaborated with the Bureau of Land Management to assess the public lands renewable resource potential (DOE/DOE 2003).

This information informs the planning of the Tribal Energy Program. The program will proceed with central station development of wind resources, followed by biomass resources. Biomass was found to show the most potential for central station development on tribal lands; and, thus, would be expected to reach an assumed parity with wind development in terms of capacity additions (TEP 2005b).

Baseline market acceptance. The WIP program attributed the estimated outcome entirely to the success of this program. However, in many cases, the program funds are leveraged with many other sources such as tribal, State, other Federal, and local grants. The basis for this attribution is that were DOE not leading this activity, these development projects would never occur. There are no standard leverage formulas to apply uniformly. The WIP program did not analyze whether success of this program would eventually lead to the private-sector involvement in developing the new renewables capacity on tribal lands in later years, but such an outcome would be possible under the right pricing conditions.

3.1.3 Key Factors in Shaping Market Adoption of EERE Technologies

Price. To enable analysis, the WIP program assumed the cost of leased solar arrays and battery storage of electricity to be less than the consumer costs of extending electrical transmission from the nearest electrical utility. For central station development, the WIP program assumed the electricity resource produced from renewable resources would cost less than utility-supplied electricity provided to the immediate tribal land with jurisdiction.

Nonprice factors.

- **Key consumer preferences/values:** This program seeks to establish electrical service for households currently without electricity on tribal lands. This is not a comparison of alternative electrical services or of using renewable fuels to provide electrical service, but rather a characterization of providing electrical service where none currently exists, using fuels and facilities that are within the control of tribal organizations.
- **Manufacturing factors:** Based on program materials and TEP program Web site documents (TEP 2004, 2005a, 2005b), most current activities are focused on development of wind resources. EIA (2000) suggests that biomass provides the greatest potential for central station power at competitive prices; therefore, the WIP program assumed that an even mix of technology will develop over time.
- **Policy factors:** Having renewable resources in the resource stack for utilities continues to increase in popularity with all customer classes, even at cost premiums. Central station facilities on tribal lands utilizing renewable fuels may generate value streams from off-reservation utility interests.

3.1.4 Methodology and Calculations

To permit analysis of program success, the WIP program made several enabling assumptions in consultation with the Tribal Energy Program:

- Achieving the program goal of 1,000 MW in new renewables capacity on tribal lands by 2012 would represent approximately 20% of the total potential capacity, or 5,000 MW.
- Current development efforts are almost all wind projects, but the mix will likely shift over time to an even split between wind capacity and biomass capacity for central station development over the next 20 years.
- New biomass plants would operate at a capacity factor of 80%, on average.
- For solar electrification, EIA (2000) states that roughly 16,000 reservation households are without electricity access. As a reasonable assumption, the efforts of the program lead to a potential to electrify 10,000 of those households in 20 years.

Table J-10 provides the inputs needed to develop the benefit metrics in the integrated models. Based on the enabling assumption presented above, the viability of biomass versus wind as a renewable fuel on tribal lands will cause the biomass share of new capacity additions to overtake that of new wind resources over the next 20 years. Also, the WIP program assumed the capacity factor of new wind resources would increase from 15% currently to 30% within 20 years, while the new biomass capacity factor would increase from 80% to 90% over the same period.

Table J-11 provides the development of the off-grid PV electrification of tribal households in the Desert Southwest. The WIP program assumed a capacity factor of 20% for new PV systems deployed in that region, and also assumed the average system would be rated for 1.2 kW capacity. The Navajo tribe and other program material indicate that there are at least 18,000 Navajo reservation households without electricity access. An arbitrary assumption was made to facilitate analysis—that the actions of the program could lead to providing distributed solar/PV to 10,000 households. The default system was assumed to be 1.2 kW.

Table J-10. Development of Tribal Renewable Energy Capacity resulting from the FY2007 Budget Assumptions

Year	Fraction of Potential	MW capacity (cumulative)	Added MW	Share Assumptions		Added MW			Cumulative MW		Capacity factor	
				Wind Fraction	Biomass Fraction	Wind	Biomass	Total	Wind	Biomass	Wind	Biomass
2007	0.011	45	45	1.00	0.00	45	0	45	45	0	0.150	0.750
2008	0.020	100	55	1.00	0.00	55	0	55	100	0	0.158	0.758
2009	0.037	185	85	0.95	0.05	81	4	85	181	4	0.167	0.767
2010	0.067	335	150	0.95	0.05	143	8	150	323	12	0.175	0.775
2011	0.118	590	255	0.95	0.05	242	13	255	566	25	0.183	0.783
2012	0.200	1000	410	0.50	0.50	205	205	410	771	230	0.200	0.792
2013	0.319	1595	595	0.50	0.50	298	298	595	1,068	527	0.206	0.800
2014	0.468	2340	745	0.50	0.50	373	373	745	1,441	900	0.211	0.806
2015	0.622	3110	770	0.50	0.50	385	385	770	1,826	1,285	0.217	0.811
2016	0.755	3775	665	0.50	0.50	333	333	665	2,158	1,617	0.222	0.817
2017	0.852	4260	485	0.50	0.50	243	243	485	2,401	1,860	0.228	0.822
2018	0.900	4500	240	0.25	0.75	60	180	240	2,461	2,040	0.233	0.828
2019	0.911	4556	56	0.25	0.75	14	42	56	2,475	2,082	0.239	0.833
2020	0.922	4611	55	0.25	0.75	14	41	55	2,488	2,123	0.244	0.839
2021	0.933	4667	56	0.25	0.75	14	42	56	2,502	2,165	0.250	0.844
2022	0.944	4722	55	0.25	0.75	14	41	55	2,516	2,206	0.260	0.850
2023	0.956	4778	56	0.25	0.75	14	42	56	2,530	2,248	0.268	0.868
2024	0.967	4833	55	0.25	0.75	14	41	55	2,544	2,289	0.276	0.876
2025	0.978	4889	56	0.25	0.75	14	42	56	2,558	2,331	0.284	0.884
2026	0.989	4944	55	0.25	0.75	14	41	55	2,572	2,373	0.292	0.892
2027	1.000	5000	56	0.25	0.75	14	42	56	2,586	2,415	0.300	0.900

Note: Based on enabling assumptions indicated in the text.

Table J-11. Development of Off-Grid Solar PV Capacity resulting from FY2007 Budget Assumptions

Year	Cumulative Households	MW Capacity	MWh
2007	110	0.13	231
2008	200	0.24	420
2009	370	0.44	778
2010	670	0.80	1,409
2011	1,180	1.42	2,481
2012	2,000	2.40	4,205
2013	2,533	3.04	5,326
2014	3,067	3.68	6,447
2015	3,600	4.32	7,569
2016	4,133	4.96	8,690
2017	4,667	5.60	9,811
2018	5,200	6.24	10,932
2019	5,733	6.88	12,054
2020	6,267	7.52	13,175
2021	6,800	8.16	14,296
2022	7,333	8.80	15,418
2023	7,867	9.44	16,539
2024	8,400	10.08	17,660
2025	8,933	10.72	18,781
2026	9,467	11.36	19,903
2027	10,000	12.00	21,024

3.1.5 Sources

1) Energy Information Administration (EIA 2000). Energy Consumption and Renewable Energy Development Potential on Indian Lands, SR/CNEAF/2000-01, available online at: http://www.eia.doe.gov/cneaf/solar.renewables/ilands/ilands_sum.html
2) DOE/DOI (2003). Assessing the Potential for Renewable Energy on Public Lands, Joint report from the Bureau of Land Management and the National Renewable Energy Laboratory, DOE/GO-102003-1704, February 2003.
3) Tribal Energy Program (TEP 2004). FY 2004 Peer Review Meeting, Roadmap and Metrics presentation, available online at: http://www.eere.energy.gov/tribalenergy/pdfs/7_road_map_metrics.pdf
4) Tribal Energy Program (TEP 2005a). DOE's Tribal Energy Program, Program Review, October 17, 2005. Available at: http://www.eere.energy.gov/tribalenergy/pdfs/0510review_tep.pdf
5) Tribal Energy Program (TEP 2005b). Email communication (6/28/2005) with Thom Sacco, Native American and International Programs Office of Weatherization and Intergovernmental Programs.

3.2 International Renewable Energy Program

The International Renewable Energy Program promotes market transformation in international energy markets to increase the installation of U.S.-developed technologies.

The program states the goal of developing 1,000 MW of new renewables capacity worldwide by 2010. Even if all of this new generation displaced fossil generation, the savings are insignificant—especially on a world scale. In many instances, the new generation that would be created would serve to electrify currently unelectrified regions of the world—adding to world energy consumption. About 1,000 MW each five years would be equivalent to replacing one moderate-sized coal or oil-fired power plant each five years.

The activities of the program are more consistent with information programs and other outreach activities. The difference being that these activities occur with foreign governments. These activities could have the effect of placing U.S. technologies in foreign countries for demonstration or deployment, which may lead to potential adoption in the United States as a result, but this linkage is tenuous at best.

Based on these observations, analysis effort has been focused elsewhere.