



Priority Lists: *Getting Your Priorities Straight*

2008 Energy OutWest Conference
Scottsdale, Arizona
June 2-6, 2008



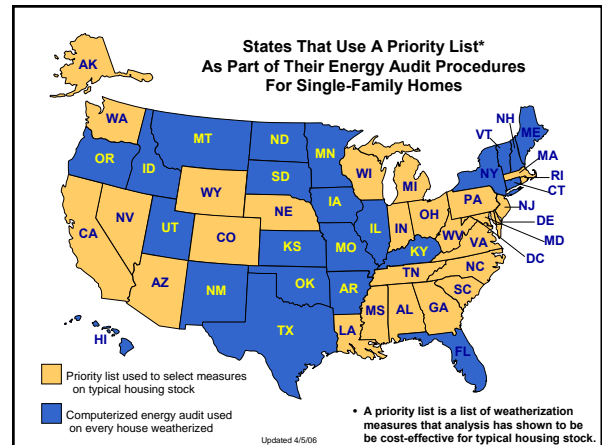

Overview

- What's a priority list?
- Why do I care?
- How do I develop a priority list?
- Measure-specific considerations
- What's a priority list look like?
 - Priority lists from other states
- Priority list assistance




What's a Priority List?

- List of weatherization measures that are generally cost effective in typical houses
 - Theoretically, listed in order of cost effectiveness
 - Realistically, listed in order of installation or by functional group
- Based on application of DOE-approved audit tool on representative housing stock, fuel prices, and measure costs

Priority Lists

- 26 states use priority lists to select measures
- A poorly designed list can allow expenditure of funds on measures that are not cost effective
- A well-designed list can prevent the omission of cost-effective measures resulting from audit tool user errors
- Priority lists can, in some instances, facilitate technical monitoring



Priority List – A Package of Measures


- A priority list describes a package of measures to be installed in typical homes
- Cannot pick and choose individual measures
- Exceptions
 - Expenditure limit impacts
 - Existing conditions
 - House characteristics




High-Priority Measures



- The following measures rank highest in priority on most lists:
 - Air sealing
 - Attic insulation
 - Dense-pack sidewall insulation
 - Floor insulation
 - Duct sealing and insulation
 - Smart thermostats
 - Incandescent-to-CFL lighting conversions
 - Refrigerator replacement



How Do I Develop A Priority List?




- Determine typical housing stock
- Determine representative weather sites
- Collect actual material and labor costs for typical measures
- Sample energy audit software runs




Determine Typical Housing Stock







Determine Typical Housing Stock




- 1-story Ranch, 1½ Cape Cod, 2-story Colonial
- Basement, crawl space, slab
 - Conditioned, unconditioned, unintentionally conditioned
- Type of heating fuel
- Type of heating and cooling system
 - Location of ducts
- Existing infiltration and insulation




Representative Weather Sites




- The most representative weather site for a particular area may be in another state
- Not just a matter of heating and cool degree days
 - Solar insolation including effects of cloud cover
 - Wet- & dry-bulb temps for latent load calculations
 - Wind speeds for surface film coefficients
 - Mean design temps for load calculations
- Mountain, plains, coastal???



Actual Measure Costs



- Collect actual material and labor costs for typical measures
 - Determine \$/sq ft for different R-values for attics, walls, floors, and perimeters
 - May be beneficial to break out materials and labor \$/sq ft (more about this later)
- Do costs vary across the state?




Energy Audit Software Runs

- **Assess sensitivity of measure SIR to:**
 - Climate
 - Fuel type and heating system
 - Cost of measure
 - Existing level of insulation
- **May be able to simplify priority list depending on SIR sensitivity**




Simple or Comprehensive?

- **To simplify the priority list, use the:**
 - Lowest fuel prices in state
 - Highest measure costs in state
 - Mildest climate in state
- **Simplified priority lists yield more consistent guidelines statewide**
 - But result in some missed opportunities for clients



Energy Audit Software Runs

- **WPN 01-4 gives number of runs required, but number is flexible**
- **Number of runs required depends on:**
 - Variation in climate, fuel prices, and measure costs across state
 - Housing characteristics
 - Types of measures
 - Typical heating and cooling systems
 - Heating fuel type
- **Can configure house to minimize runs**



Minimize Energy Audit Software Runs

- **Unfinished attics**
 - A1: No insulation
 - A2: R-11 insulation
 - A3: R-19 insulation
 - A4: R-30 insulation
- **Setup**
 - Run once with all attic insulation measures enabled
 - NEAT will select R-value with $SIR \geq 1$ and highest present value
 - Disable certain measures to see if higher R-value is cost effective



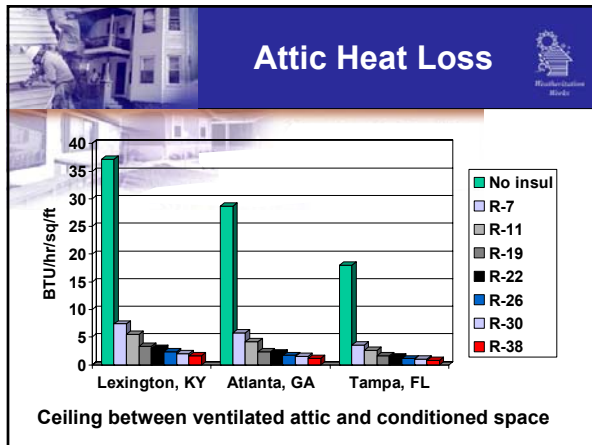
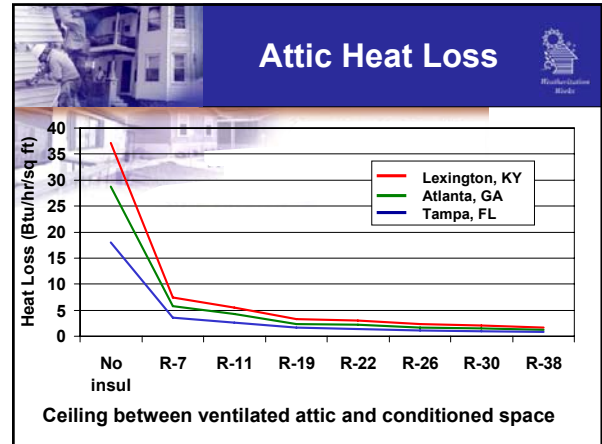
Attic Insulation Considerations

- **Post-weatherization R-value**
- **Threshold level of existing insulation**



Existing Attic Insulation





Existing Attic Insulation Threshold

Pre-Wx	Post-Wx (R-30, 2,400 Btu/hr)	Savings	Cost	SIR
R-0 44,000 Btu/hr		\$346	\$758	6.4
R-11 5,900 Btu/hr		\$48	\$542	1.2
R-19 3,750 Btu/hr		\$21	\$367	0.8

- ## Existing Insulation Thresholds Revisited
- Insulate attics to R-38 if existing insulation is less than R-19
 - Attic with no existing insulation gets R-38, but
 - Attic with R-19 existing insulation gets none
 - Once a crew is in the attic, the cost per square foot to blow additional insulation is reduced (but must document)
 - Compromise: If at least half the attic has less than R-19 existing insulation, entire attic may be insulated to R-38

- ## Wall Insulation Considerations
- NEAT and other energy audit software do not recommend adding sidewall insulation if there is ANY existing wall insulation
 - NEAT and other energy audit software do not credit dense-pack sidewall insulation with air-sealing benefits
 - Auditors' judgment if dense-packing already insulated wall is practical and beneficial
 - Zone pressures?

Floor/Foundation Insulation

- Different foundation/basement types impact effectiveness of floor and foundation wall insulation
 - Crawl space, basement
 - Conditioned, unintentionally conditioned, unconditioned
 - Occupied, unoccupied
- Tendency of floor insulation to sag over time raises questions about the long-term persistence of energy savings

Air Sealing Considerations

- Building tightness limits
- Closure targets
- Cost-effectiveness guidelines

Blower Door

State Program Standards (example only)
 Pre- and post-weatherization blower door tests are required.
 Building Tightness Limit computed per BTLA.
 Closure targets:

Pre-weatherization air changes per hour @ 50 Pa	Recommended Percentage Reduction
0 – 5 ACH@50 Pa	No sealing work should be attempted. Mechanical ventilation may be needed.
6 – 10 ACH@50 Pa	Only major bypasses should be addressed.
11 – 17 ACH@50 Pa	Reduce infiltration a minimum of 25%.
18 – 22 ACH@50 Pa	Reduce infiltration a minimum of 35%.
23 or more ACH@50 Pa	Reduce infiltration a minimum of 40%.

	CFM ₅₀ @ 50 Pa	ACH@50 Pa	Total occupancy	# of bedrooms	# of bedrooms	Heated volume	person	bedrooms	ft ³
Pre-weatherization	CFM ₅₀	ACH ₅₀							
Post-weatherization	CFM ₅₀	ACH ₅₀							
BTLA	CFM ₅₀	ACH ₅₀							

Air-Sealing Guidelines

- After sealing the typical attic and floor bypasses, the CFM₅₀ still exceeds the target
 - How much can you spend to try to reach target?
- Additional air sealing needs to be directed by separate cost-effectiveness guidelines

Air-Sealing Guidelines

- Determine maximum cost that can be spent to reduce infiltration by 100 CFM₅₀ while maintaining a SIR≥1
- Crew takes periodic blower door readings during course of air sealing work
- With each reading, compute \$ per 100 CFM₅₀ reduction
- Air sealing continues until \$/100 CFM₅₀ exceeds cost-effective maximum

The screenshot shows the 'Weatherization Assistant (0.2.7.6)' interface. The main window displays 'WHOLE HOUSE INFILTRATION REDUCTION WITH BLOWER DOOR' with the following data:

	Pre Infiltration Reduction	Post Infiltration Reduction/Target
Whole House Leakage (CFM) at Pressure Differential (Pa)	3400 / 50	3300 / 50
Infiltration Reduction Cost (\$)	\$50.00	

At the bottom, it states: 'The minimum recommended CFM at 50Pa is: 1427 CFM'.

Audit Name Test Attic Insulation Levels **Client ID** MD Priority List Review **Client Name** Crawford

Audit Information | Status | Shell | Heating (1) | Cooling (1) | **Ducts/Infiltration** | Baseloads | Health & Safety | Infiltration

Air and Duct Leakages | Optional Blower Door and Zonal Pressures (0) | Optional Pressure Balance (0) | Optional Infiltration

Evaluate Duct Sealing?

WHOLE HOUSE INFILTRATION REDUCTION WITH BLOWER DOOR

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Whole House Leakage (CFM) at Pressure Differential (Pa)	3400	3300
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The minimum recommended CFM at 50Pa is: 1427 CFM.

Report: [Recommended Measures]

Energy Saving Measure Economics

Index	Recommended Measure	Components	Measure Savings (\$/yr)	Measure Cost (\$)	Measure SIR	Cumulative Cost (\$)	Cumulative SIR
1	Infiltration Reductn		5	50	0.8	50	0.8
2	DVWH Pipe Insulation		15	15	10.1	65	3.0
3	DVWH Tank Insulation		27	40	6.8	105	4.4
4	Wall Insulation	WL1-N,WL2-S,WL3-E,WL4-W	137	996	1.9	1101	2.2
5	Floor Ins. R-19	F1	102	950	1.5	2091	1.8
6	Attic Ins. R-19	A1	49	616	1.1	2667	1.7
7	Window Sealing	WE1,WWE2,WVW1,WVW2,WVW3	13	150	0.7	2817	1.6
8	Storm Windows	WN2,WVW3,WVW3,WS2	10	566	0.2	3382	1.4

Materials

Index	Material	Type	Quantity	Units
<i>Audit Name: Test Attic Insulation Levels Client: MD Priority List Review Date: 11/13/2006 Page 1 of 3</i>				

Energy Saving Measure Economics

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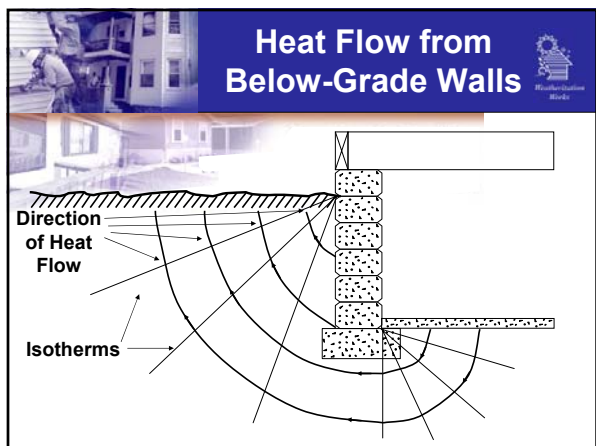
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Air-Sealing Guidelines

Maximum Air-Sealing Cost per 100 CFM@50 Pa

Space Heating Fuel/Equipment	Region 1 North	Region 2 Central	Region 3 South
Natural Gas	\$55/\$58*	\$43/\$49*	\$21/\$40*
Propane	\$87/\$90*	\$53/\$65*	\$33/\$51*
Heat Pump	\$43	\$36	\$35
Electric Resistance	\$84/\$87*	\$52/\$63*	\$32/\$51*

* Without air conditioning/with air conditioning



- Foundation Wall Insulation**
- Heat loss through below-grade walls
 - Assuming a conditioned basement, Manual J treats a wall that does not extend more than 2 feet below grade as an above-grade wall
 - At 2 feet or more below grade, the insulating effect of the ground is more pronounced
 - Manual J reduces the heat transfer multipliers (HTMs)
 - If the bottom of the extends more than 5 feet below grade, Manual J reduces the HTM still further

Heat Loss from Below-Grade Walls

Manual J HTM (Btu/hr/sq ft)
Lexington, Atlanta, Tampa

	KY	GA	FL	
	31.6	23.9	15.3	2 ft
	7.7	5.8	3.7	5 ft
	5.3	4.1	2.6	

Duct Sealing and Insulation

- Where are ducts located?
- Pressure pan, duct blaster, blower door subtraction method
- Seal and insulate ducts in unconditioned space
 - Temperatures in crawlspaces are different than in attics
 - Both are different than outside
- Seal accessible ducts in conditioned space
 - Supply and return ducts near air handler where pressures are highest

Smart Thermostats

- Can result in call-backs
- Many clients do not want them
 - Too complicated
 - Do not want temperature set back
- Some studies question savings
- Do not install if the measure will not be effective

Priority List Considerations

- Incandescent-to-CFL lighting conversions
 - Current low CFL prices make them cost effective in fixtures used as little as an hour per day
 - Some states provide up to six CFLs per household even if client initially agrees to install only one or two
- Refrigerator replacement
 - Audit procedure ensures cost effectiveness
 - Actual SIR varies between households, therefore so does priority
 - Should refrigerator replacement supplant air sealing and insulation?

NEAT Results

- Look at spreadsheet of sample NEAT results

Other Issues

- A priority list is just one part of good program documentation
- Program standards can include:
 - Health and safety procedures
 - Action levels
 - H&S measures not subject to cost-effectiveness requirements
 - Diagnostic procedures
 - Priority list
 - Situations that require site-specific audit
 - Installation standards

What's A Priority List Look Like?

- **Samples from:**
 - Indiana
 - Ohio
 - Georgia

Indiana's Priority List

- **Health & safety**
- **Blower-door-directed air sealing**
 - Seal major air leaks & bypasses
 - Seal ducts
- **Insulate water heater tank and pipes, install low-flow showerheads and faucet aerators**
- **Furnace tune-up**
- **CFLs**
- **Insulate uninsulated attics to R-38**

Indiana's Priority List

- **Insulate uninsulated walls to R-15**
 - High density tube-in
- **Insulate attics with existing insulation < R-13 to R-38**
- **Insulate sillboxes to R-19**
- **Insulate foundation**
- **Other measures**
 - Replace refrigerator
 - Repairs, miscellaneous
- **Minor air sealing**

Ohio's Priority List

Required Measures

- **General heat waste reduction measures**
- **Attic insulation**
 - If existing insulation is R-19 or less, add to R-38
 - If existing > R-19, must run NEAT to justify more
- **Sidewall insulation**
 - Uninsulated walls to R-15
 - Auditor's judgement if existing wall insulation

Ohio's Priority List

Required Measures

- **Foundation insulation**
 - Uninsulated floors to R-19
 - Uninsulated perimeters to R-11
- **Lighting retrofits**
- **Refrigerator replacement**

Optional Measures

- **Must be proven cost effective with NEAT**

U.S. DOE Hot Climate Initiative

PRIORITY LIST FOR SINGLE-FAMILY HOMES

Priority List for Single-Family Homes lists the weatherization measures that should be installed in Georgia single-family homes. An analysis of typical two-bedroom homes identified the following weatherization measures to be cost effective based on Georgia housing stock, energy costs, and climate conditions. The most cost-effective measures are listed first.

Typically, the first three measures—air sealing, attic insulation, and dense-pack cellulose insulation—should be installed as a package. The remaining measures should be installed, in order, as available. Dense and insulating doors. The specific order should be negotiated for unusual single-family homes or when measures are listed below appear suitable for a particular home.

Ensuring the health and safety of clients, contractors, and field staff personnel is an important component of the Weatherization Assistance Program. Health and safety inspection and testing should be conducted before delivery of weatherization services and after completion of work.

AIR SEALING

- Use the blower door and digital measures to guide air sealing.
- Demonstrate the densest target substrate building reduction, perform blower door test, and fast the densest target on the side perimeter during testing.
- Demonstrate the Maximum Ventilation Rate (Building Tightness Limit (MVR/BTL)) of each house. Remove and locate the least. Fans and windows require airtight sealant.
- Seal plumbing, electrical, and HVAC penetrations through ceiling, flooring, and exterior walls. Use proper materials for high-temperature reduction.
- Add weather weatherstrips where doors are not sealed too tightly. Check the MVR/BTL to determine how much weatherization is required.

GEORGIA

