



**W02 Designing a Priority List**

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**Objectives**

- Discover how priority lists can simplify the selection of cost-effective Weatherization measures
- Learn how to develop a priority list by applying DOE-approved energy audit software to representative housing stock
- Identify procedures for developing and submitting a priority list for approval
- Understand the pros and cons of using priority lists




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**Simplify the selection of cost-effective measures**

- 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




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### What is SIR?

- Savings-to-Investment Ratio
- Economic tool to decide when measure can be installed
- Savings-
  - Net Present Value
    - Real Discount Rate
  - Annual Energy Savings
    - First year savings
    - Fuel price inflator/deflator
  - Lifetime of the Measure
    - Equipment vs. Envelope


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### What is SIR?

- Investment includes
  - Individual Measure
  - Overall SIR
- Investment does NOT include
  - Health & Safety
  - States do have a limit per household


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### 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


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### 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

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### Determine Typical Housing Stock

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### 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

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### 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


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### 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)
  - Need to account for Davis-Bacon rates
- Do costs vary across the state?


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### 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


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### 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

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### Procedures for developing and submitting a priority list

- 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

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### Procedures for developing and submitting a priority list

- States decide which tools to use
- States submit request to DOE
- 5-Year Life on the Priority List

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### 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

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### Attic Insulation Considerations

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

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### Existing Attic Insulation



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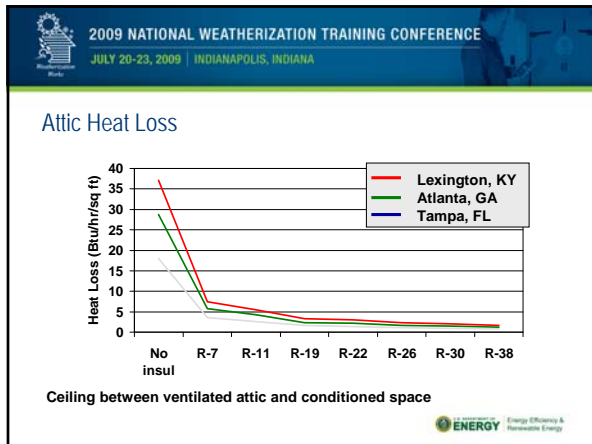
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### Existing Attic Insulation Threshold

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

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- ### 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
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### Sidewall 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

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### 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

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### Air Sealing Considerations

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

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### 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

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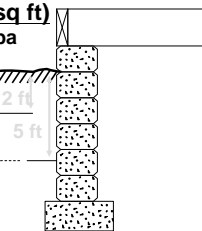


### Heat Loss from Below-Grade Walls

#### Manual J HTM (Btu/hr/sq ft)

Lexington, Atlanta, Tampa

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




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### 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

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### 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


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### 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?


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### Other Issues

- A priority list is just one part of good program documentation
- Program standards can include:
  - Health and safety procedures
  - Diagnostic procedures
  - Priority list
    - Situations that require site-specific audit
  - Installation standards


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### What's A Priority List Look Like?

- Samples from:
  - Indiana
  - Ohio
  - Georgia



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### 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



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### 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



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### 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

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### 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

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**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 low-income homes identified the following weatherization measures to be most 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 ventilation, and dense-pack mineral wool insulation—should be installed as a package. The remaining measures should be installed, in order, as weatherization dollars and funding allow. Cost-savings studies should be completed for several single-family homes in which measures are listed below appear suitable for a particular home.

Ensuring the health and safety of clients, contractors, and local agency 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 anemometer to guide air sealing.
- Determine the blower target, calculate building volume, perform blower door test, and find the blower target on the table provided during training.
- Determine the Maximum Ventilation Rate Building Tightness Limit (MVTR/BTL) of each home. Home not below the limit. Pits and voids require more ventilation.
- Seal plumbing, electrical, and HVAC penetrations through ceiling, flooring, and exterior walls. Use proper materials for high-temperature sealants.
- Add ventilation measures when homes is air sealed too tightly. Check the MVTR/BTL to determine how much ventilation is required.

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