Thinking About Tomorrow: Expanding the Rating Score - Adding Lighting, Appliances and On-Site Energy Production into the Rating

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Topics of Discussion

- Background
- History
- Process
- Guiding Principles
- Expanded HERS Score Proposal
- Impact on Rating Scores Sensitivity Analysis
- On-Site Power Generation
- Questions and Discussion

Background

- HERS Council Technical Guidelines
  - Heating, cooling, hot water
  - No data and limited support for lighting and appliances
- National Home Energy Rating Technical Guidelines
  - NASEO
  - September 1999 adoption

Background

- Mass. Lights and appliances study in 2001
- FSEC White Paper in January 2002
- RESNET Conference sessions on L&A in 2001, 2002 & 2003
- NASEO gave up Guidelines to RESNET in summer 2002

Recent History

- EPA interest in L&A in homes
  - ENERGY STAR labeled appliances
  - ENERGY STAR “Advanced Lighting Package”
- DOE interest in Building America Program
  - Benchmarking to determine value of savings
  - Expanding to include L&A
- Home Energy Magazine article
  - “Lights, Appliances and Sunshine: A New HERS?”
  - Nov./Dec. 2002
  - by Adam Gifford, CSG
- RESNET solicited comments in 2002
  - No consensus, but majority support for including L&A

Process

- October 9, 2002 - L&A Subcommittee Meeting at EEBA
- November 2002 - HERS amendments submitted
- Weekly in 2003 - RESNET Standards Committee reviewed 60+ submitted amendments, including lighting & appliances
- February 2004 - Draft amendments posted
- April 2004 - Public comments due
- July 2004 - Amendments adopted
- January 2005 - New HERS rating standards

L&A Subcommittee Members

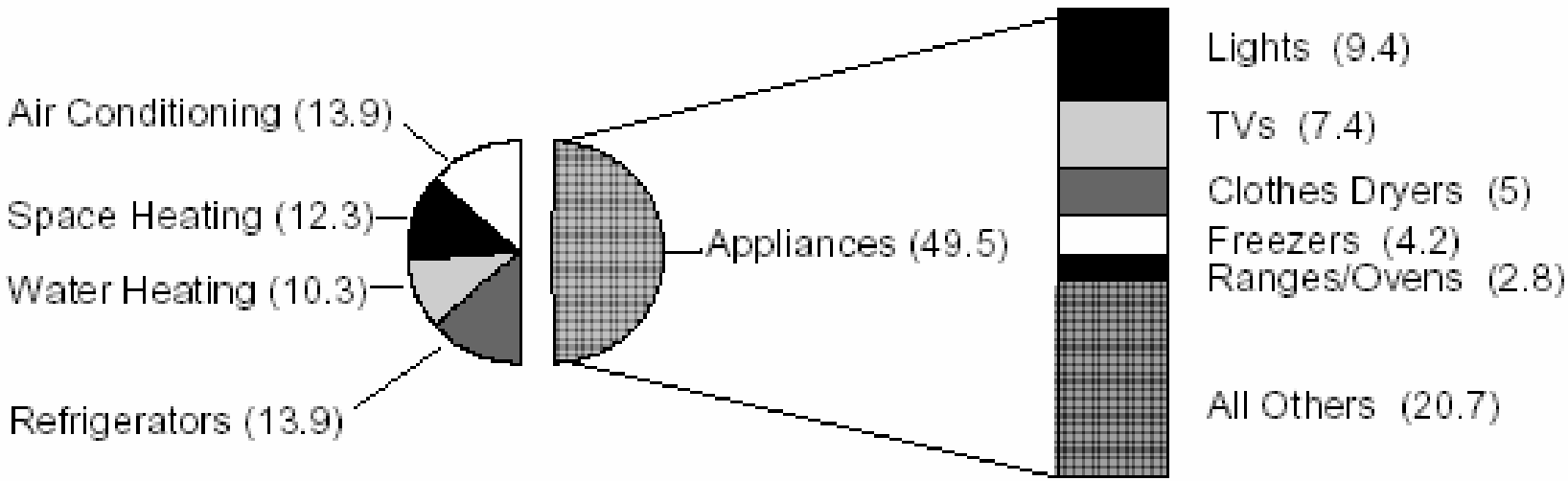
- Richard Faesy, VEIC/ERH-VT, Chair
- Ben Adams, MaGrann Assoc.
- Charles Segerstrom, PSE&G
- Danny Parker, FSEC
- Don Swift, MaGrann Assoc.
- Glenn Chinnery, EPA
- John Ashe, ICF Consulting
- Lee O'Neal, Nspects
- Megan Hoye, ICF Consulting
- Pat Haller, VEIC/ERH-VT
- Paul Vrabel, ICF Consulting
- Sue Bryant, Rater

Guiding Principles

1. The feature has to be one for which a reference level of efficiency can be defined.
2. A way must exist to cost-effectively measure the performance efficiency of the feature.
3. Rate the home, not the occupants (as much as possible)
4. Recognize and reward as much energy efficiency as possible
5. Provide a means to support programs and initiatives that promote efficiency and renewables
6. Remain as consistent as possible with current scoring methodologies

Rationale for More Rated Features

Energy Consumption By End-Use



(About the same in 1997 RECS: 47%)

Source: Energy Information Administration, 1993 Residential EnergyConsumption Survey. *Household Energy Consumption and Expenditures 1993*, Table 3.1.

Proposed Amendment

- End-Uses to Include:
  - Heating
  - Cooling
  - Hot water
  - Refrigerator(s)
  - Dishwasher(s)
  - Ventilation fan(s)
  - Lighting
  - On-site power generation

Rating Score Presentation

- Two Scores
  - Classic HERS Score
  - Expanded HERS Score
- All ratings to include Classic Score
- Presentation of Expanded Score is optional, to be determined by:
  - Program sponsor (e.g. utility, EPA, etc.)
  - HERS provider
  - HERS rater (if not specified by either above)

Lighting

- Qualifying Light Fixture Locations:
  - Everywhere except plug-in lamps, closets, unfinished basements and landscape lighting.
  - Captures ~80% of lighting kWh (various studies)
- Qualifying Fixtures:
  - Fluorescent hard-wired (pin-based) lamps w/ballasts
  - CFL screw-ins in screw-base fixtures
  - Light fixture controlled by photocell and motion sensor
- Count Fixtures
  - # of Qualifying Fixtures and all light fixtures (for ratio)
  - Built-in assumption of 10% fluorescent lighting in base case

Annual Light Fixture Usage

Annual Lighting Intensity (kWh/yr-sq.ft.) =

(98.38/CFA + 0.1730) * (FL%) +

(393.5/CFA + 0.6919) * (1-FL%)

Where:

CFA = Conditioned Floor Area

FL% = ratio of Qualifying Light Fixtures to all light fixtures in Qualifying Light Fixture Locations. Rated home can never have FL% less than 10%.

Lighting Calculation Source & Justification

- Annual lighting energy use normalized for CFA
  - Adopts DOE Building America's benchmark home
  - kWh/yr = 455 + 0.80*CFA
- 90% of annual lighting is incandescent, 10% fluorescent
- 4:1 efficacy (lumens/watt) for fluorescent over incandescent
- 10% of lighting is outdoors (reference & rated homes)
- Reference home has 10% fluorescent lighting

Lighting Calculation Source & Justification Con't

- Rated home usage is based on equation, for example:
  - 50% fluorescent: 0.6081kWh/yr-sq.ft.
    - 2,000 sq. ft. house: 1,216 kWh/year
  - 100% fluorescent: 0.2432kWh/yr-sq.ft.
    - 2,000 sq. ft. house: 486 kWh/year
- Internal gains
  - 90% of heat energy subtracted from sensible internal gains
  - 3.413 * 0.9 = 3.07 Btu for each lighting watt

Lighting Incorporation in Score

- Add lighting kWh to Reference and Rated home
- Consumption added to other end uses and used to determine house score

Appliances - Refrigerator

- 765 kWh/yr. in reference home
- 25 ft^3 automatic defrost, side-by-side, through-the-door ice model
  - Nearly the largest
  - Most popular model
  - Still some room for improvement
- Minimum Federal Standard:
  - kWh/yr. = 10.10*AV + 460.0
  - Where AV= 1.0 * refrigerator volume + 1.63 * freezer volume
- Gain or loose points depending on kWh rating of rated home refrigerator

Appliances - Dishwasher

If present:

Bedrooms	Reference Home KWh / Year	Rated Home Cycles / Year
1	90	154
2	126	214
3,4	145	247
5+	203	345

Appliances - Mechanical Ventilation

- Exhaust rate based on ASHRAE 62.2P:

$$Q_{fan}=0.01A_{floor}+7.5(N_{br}+1)$$

where:

Q_{fan} = fan flow rate in cubic feet per minute (cfm).

A_{floor} = floor area in square feet.

N_{br} = number of bedrooms; not to be less than 1.

- 62.2P requires operation for each hour

Mechanical Ventilation

- If present, reference consumption of .45 watt / cfm
- Annual ventilation energy:
  - kWh/yr. = $0.03942 * A_{floor} + 29.565 * N_{br} + 1$) in reference home.

Mechanical Ventilation in Reference Home

Bedrooms	Sq. Ft.	CFM	Annual KWh
2	1,500	37.5	148
3	2,000	50	197
4	3,000	67.5	266
5	4,000	85	335

Appliances - General

- Adjust for internal gains
- Account for increased ventilation loads on heating and cooling energy

Score Calculation

- Based on comparison of design to reference in both cases
- Classic: as-is currently

  Score = 100 - (TnML/TRL) * 20)

  $TnML = nMEUL_{htg} + nMEUL_{clg} + nMEUL_{dhw}$

  $TRL = REUL_{htg} + REUL_{clg} + REUL_{dhw}$

- Expanded:

  Score = 100 - ((TnML/TRL) * 20)

  $TnML = nMEUL_{htg} + nMEUL_{clg} + nMEUL_{dhw} + EC_{rated,\ l\&a}$

  $TRL = REUL_{htg} + REUL_{clg} + REUL_{dhw} + EC_{reference,\ l\&a}$

Score Impacts

- So, how does all of this affect rating scores?
- Dave Roberts sensitivity analysis