

Cost-Effectiveness of Green Home Programs

Jay Hall, PhD

Sept 17, 2008



building a sustainable future...

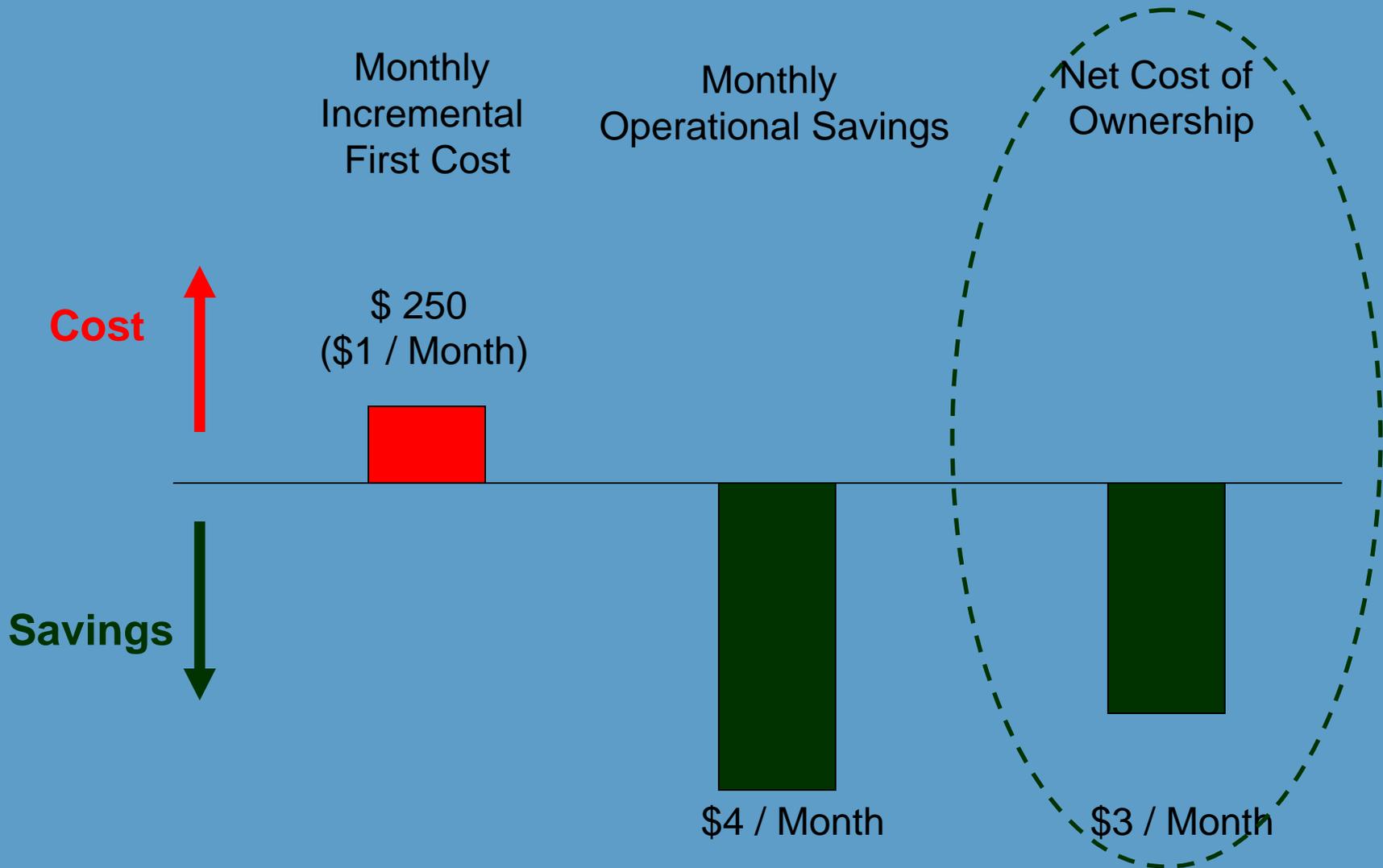
How to Measure Cost Effectiveness?

- Incremental First Cost
 - Monthly / Amortized Cost
- Monthly Savings
- Net Cost of Ownership
 - = Monthly Cost - Monthly Savings



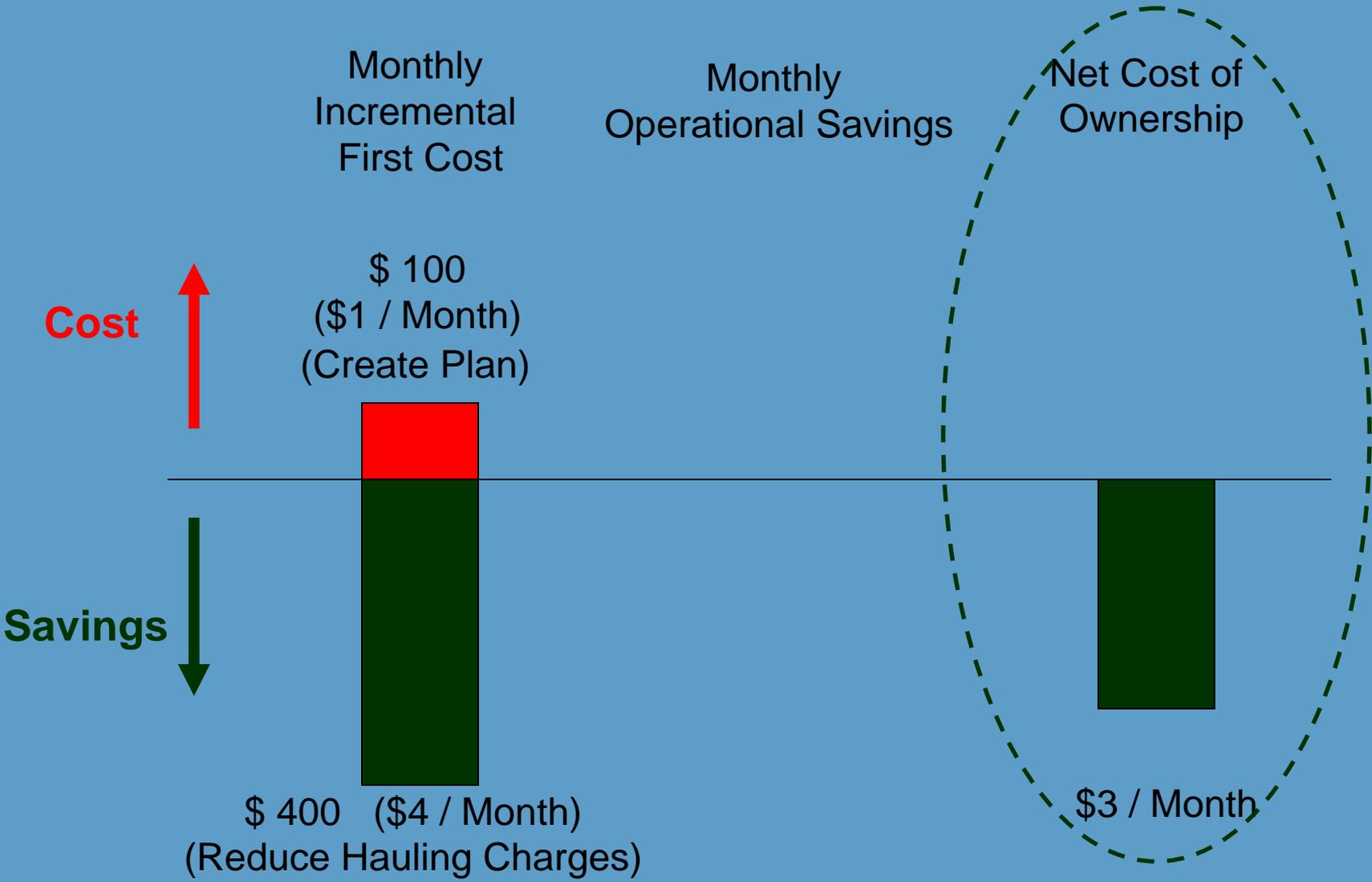
Example #1

Reduce Infiltration to 6.0 ACH50



Example #1b

Construction Waste Reduction



Example #2

No Garage

Monthly
Incremental
First Cost
\$0 / Month

Monthly
Operational Savings

Net Cost of
Ownership



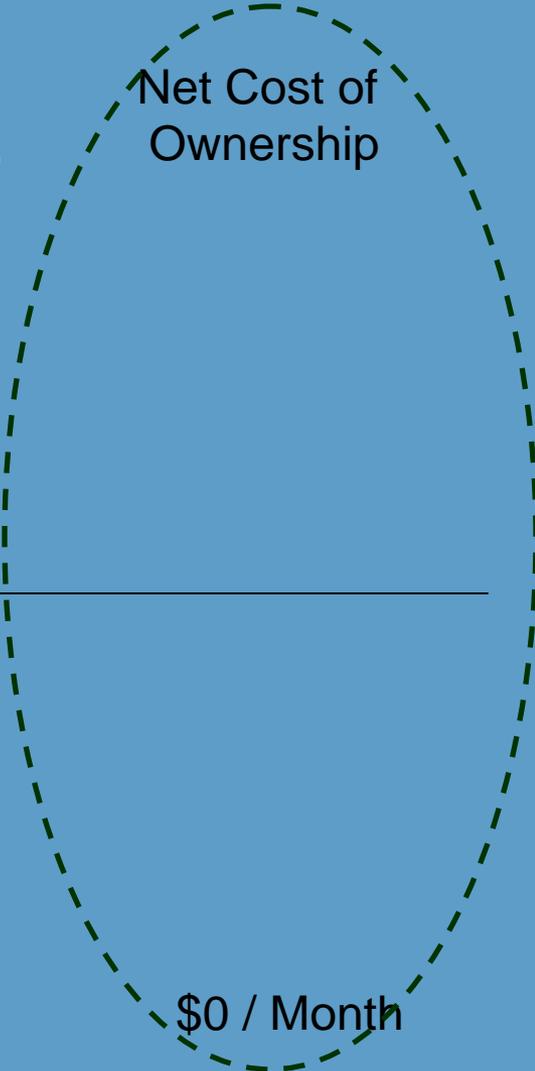
Cost



Savings

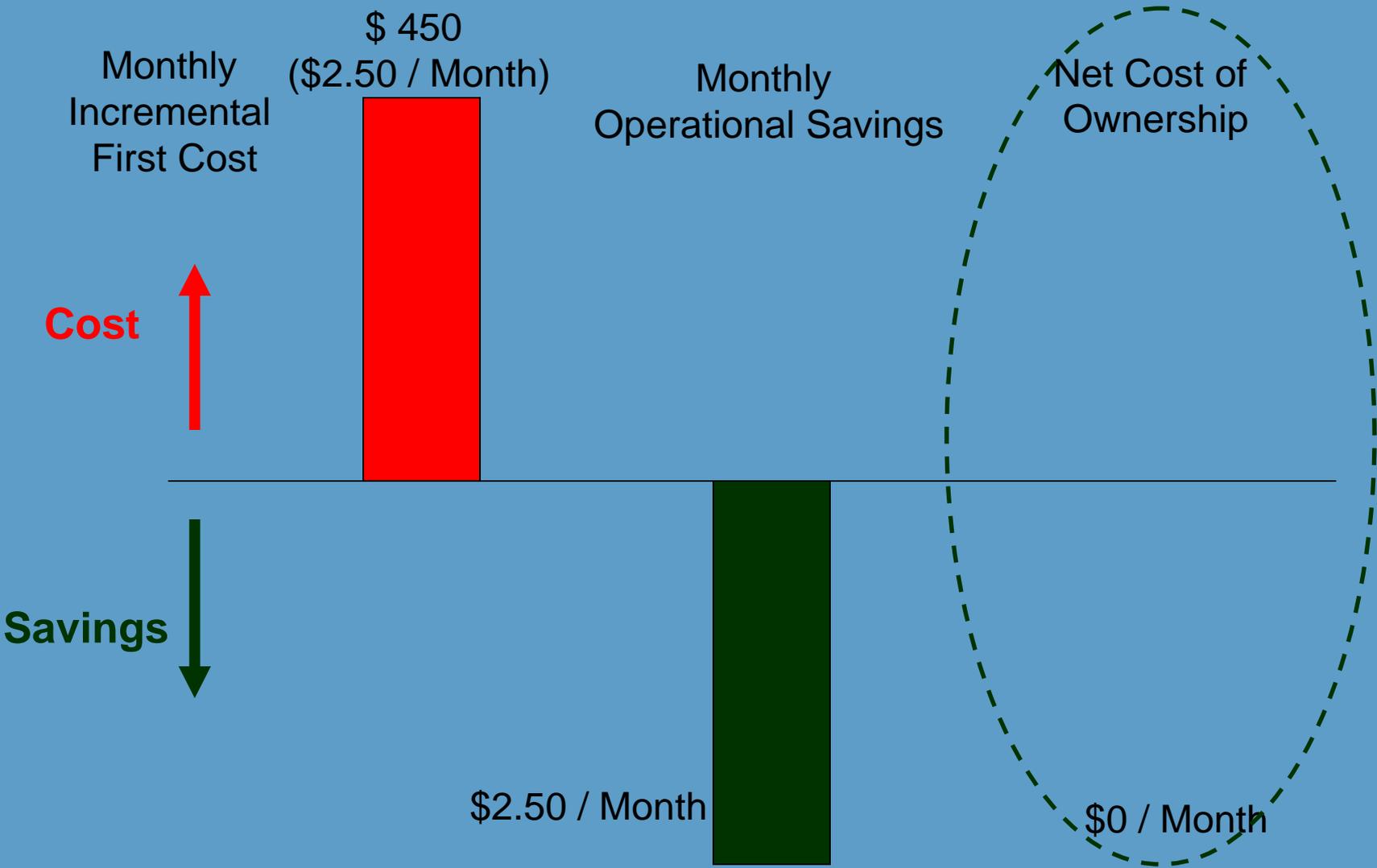
\$0 / Month

\$0 / Month



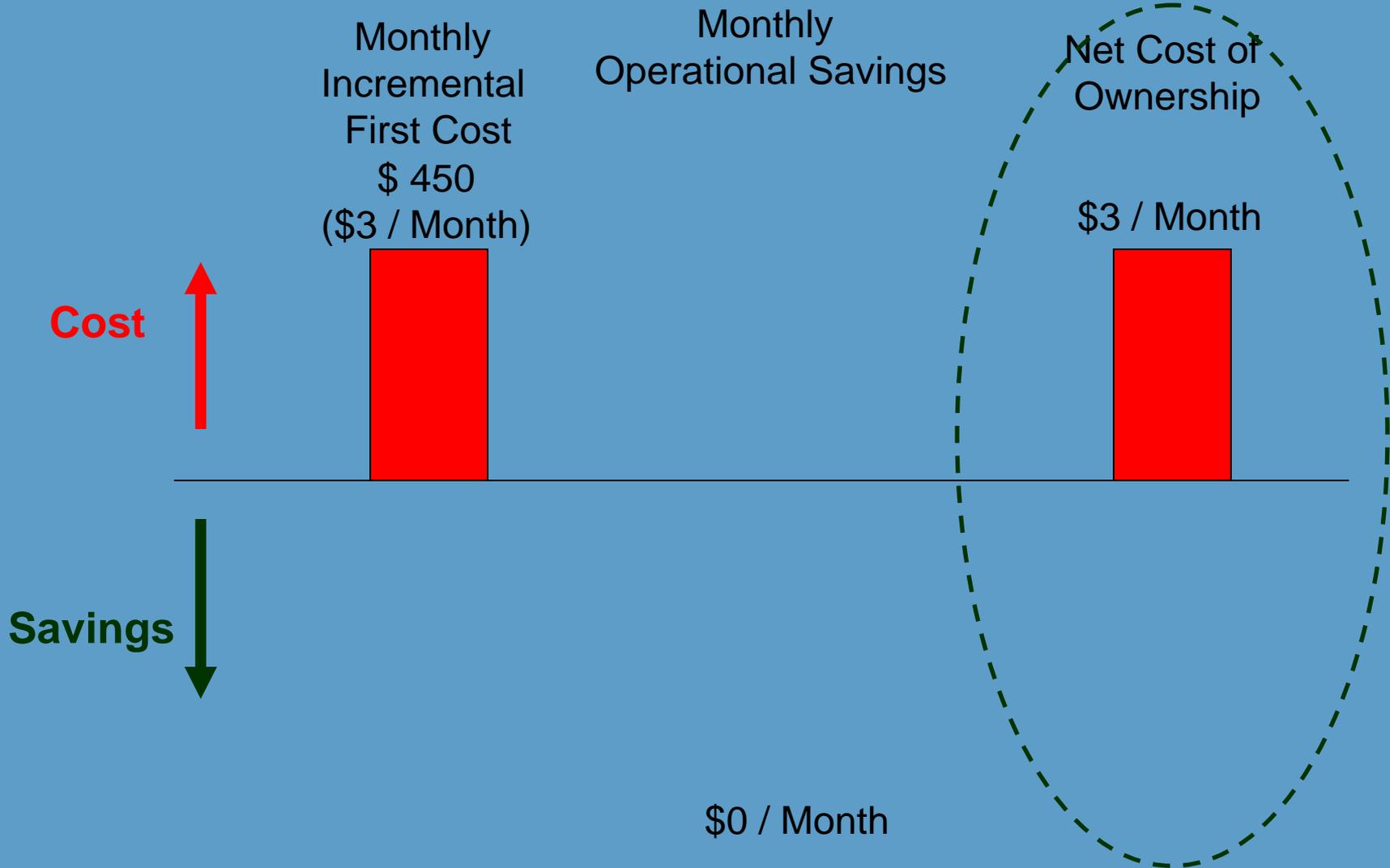
Example #2b

High Efficiency Appliances



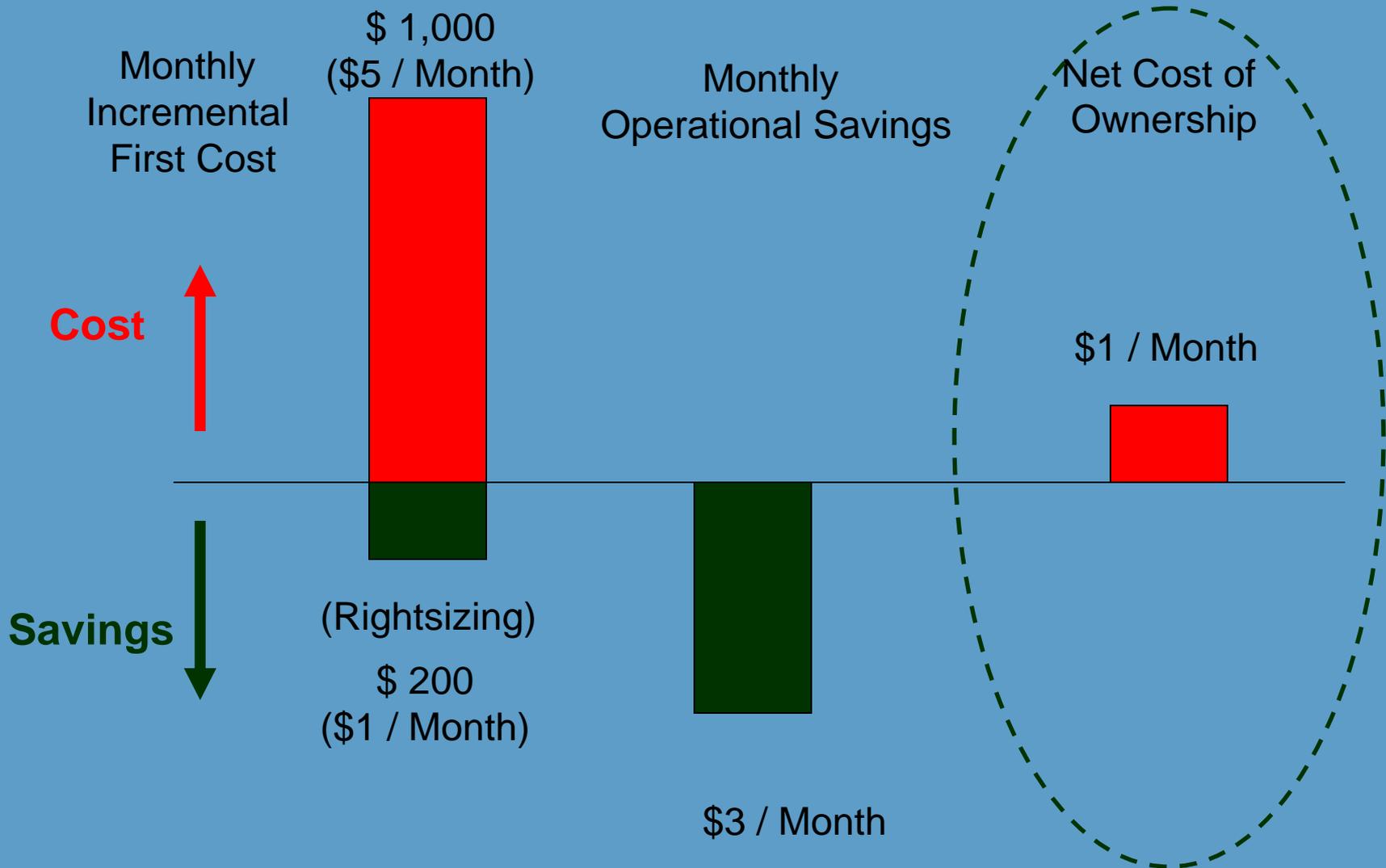
Example #3

CO Combustion Venting

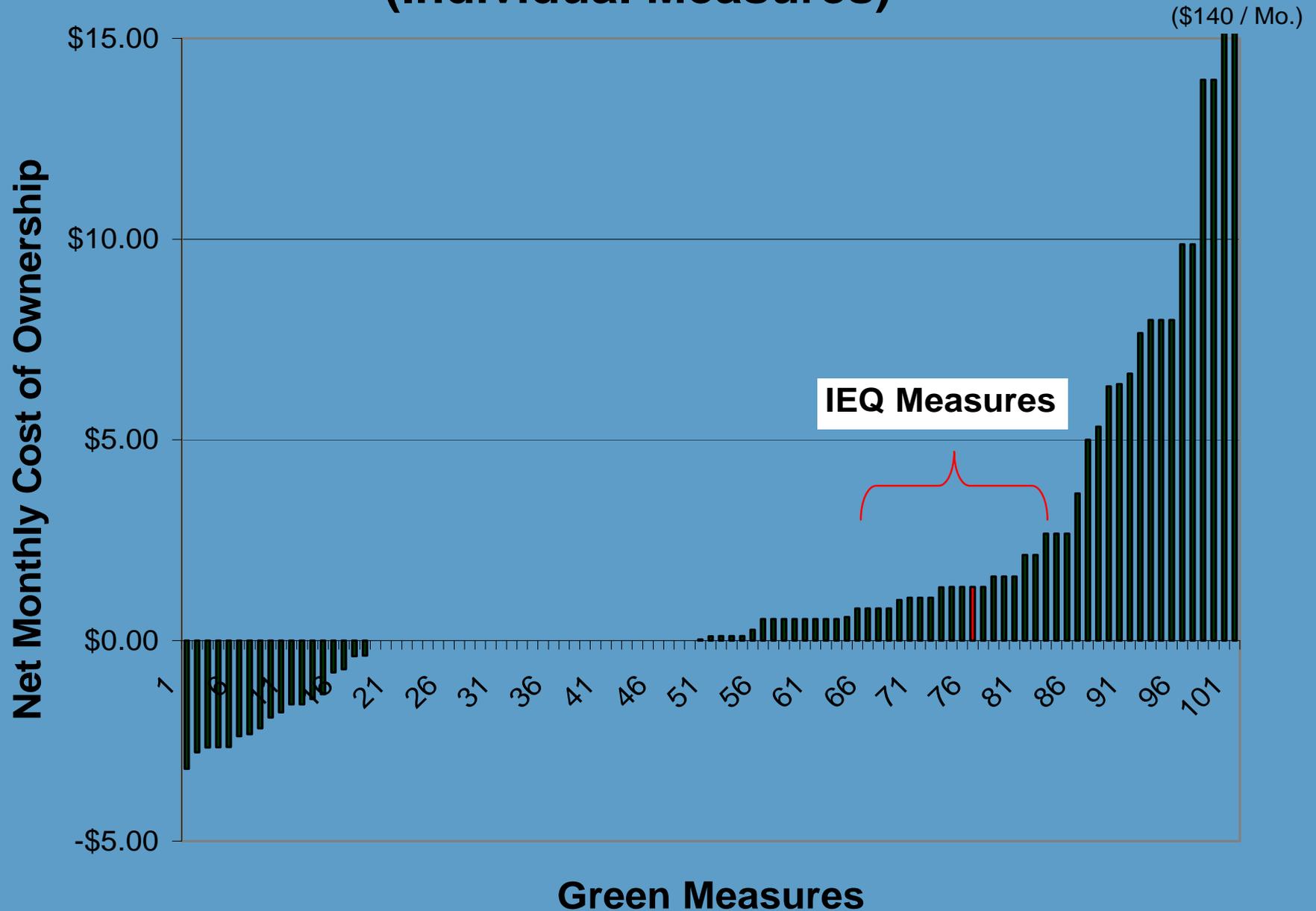


Example #3b

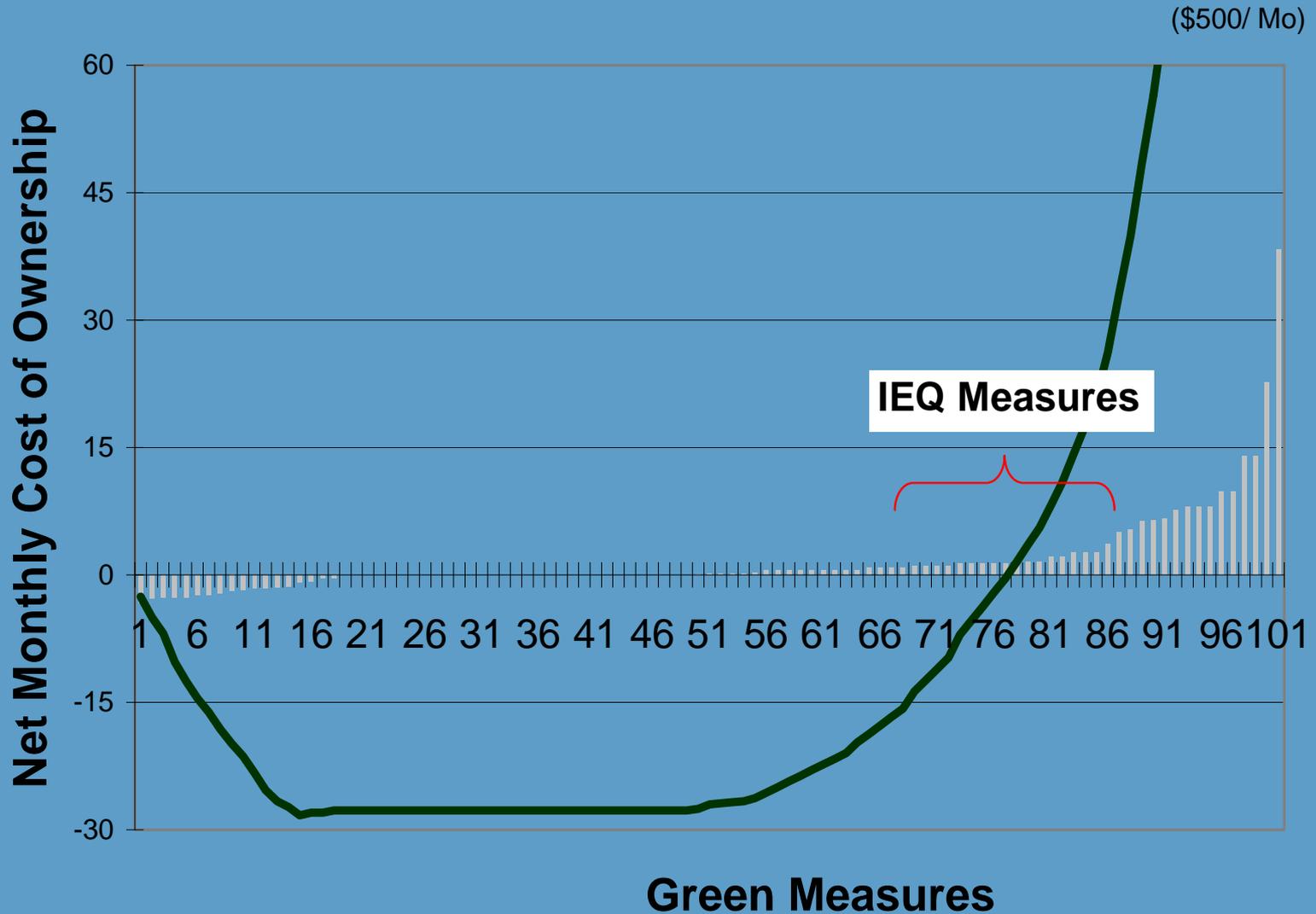
High Efficiency & Rightsized HVAC



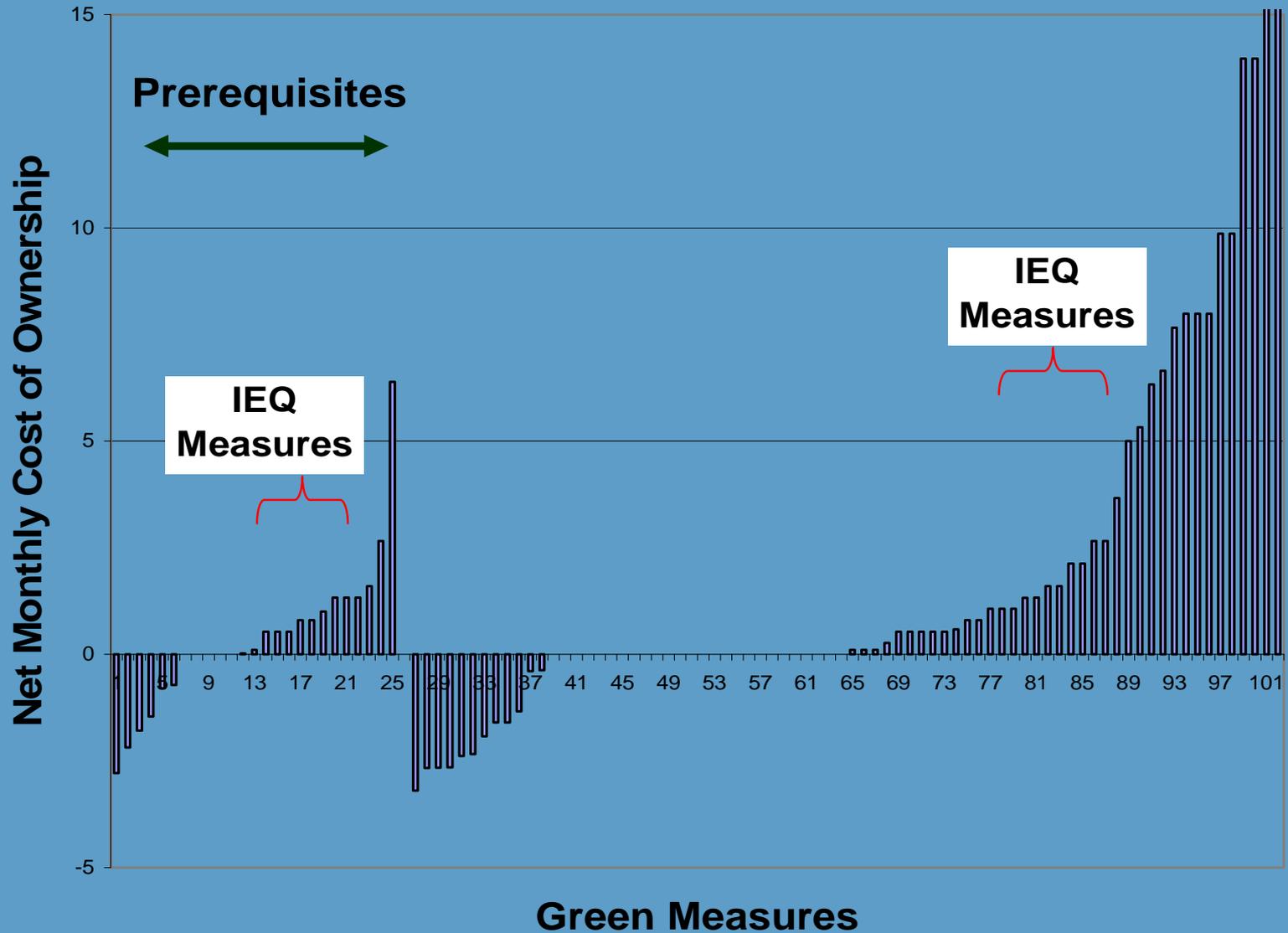
Relative Cost Effectiveness of Green Measures (Individual Measures)



Relative Cost Effectiveness of Green Measures (All Measures Combined)

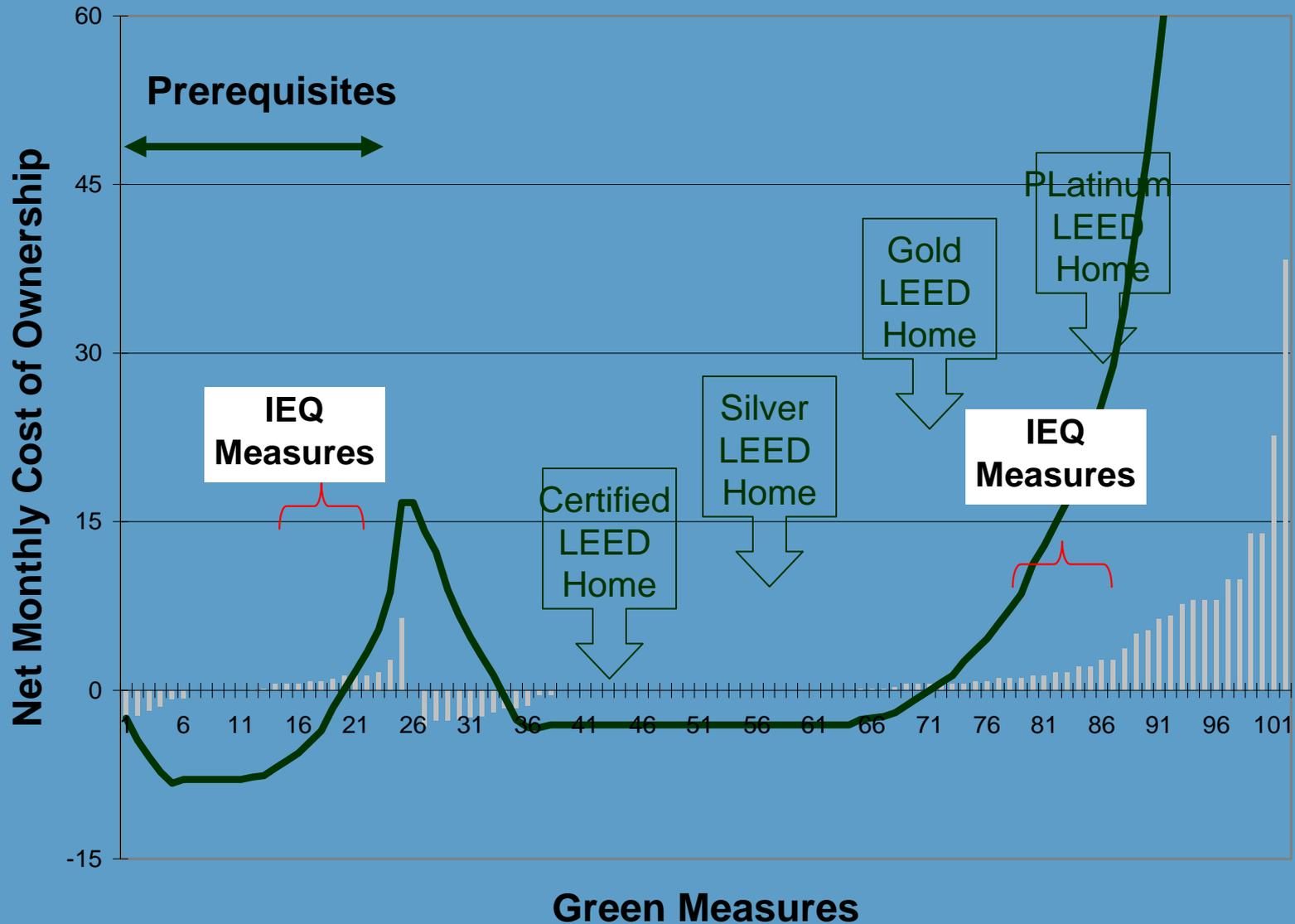


Relative Cost-Effectiveness of Green Measures



Relative Cost Effectiveness of Green Measures

All Measures Combined



List of Cost-Effective Measures

Type of Measure	Description of Measure
1. Water Heating	Efficient Distribution System
2. Air Infiltration	Good Envelope (Prereq)
3. Water Heating	Efficient Water Heating Equipment
4. Waste Management	Construction Waste Reduction
5. Air Infiltration	Better Envelope
6. Air Infiltration	Best Envelope
7. Integrated Project Planning	Preliminary Rating
8. Insulation	Basic Insulation (Prereq)
9. Insulation	Enhanced Insulation
10. Duct Tightness	Reduced Distribution Losses (Prereq)
11. Landscaping	Limit Conventional Turf
12. Material Efficient Framing	Framing Efficiencies
13. Refrigerant Management	Refrigerant Charge Test (Prereq)
14. Irrigation System	Select High Efficiency Measures from List
15. Waste Management	Construction Waste Management Plan

Method for Comparing Programs

Type of Measure

Actual Scores

	Program A	Program B		
--	-----------	-----------	--	--

Measure #1

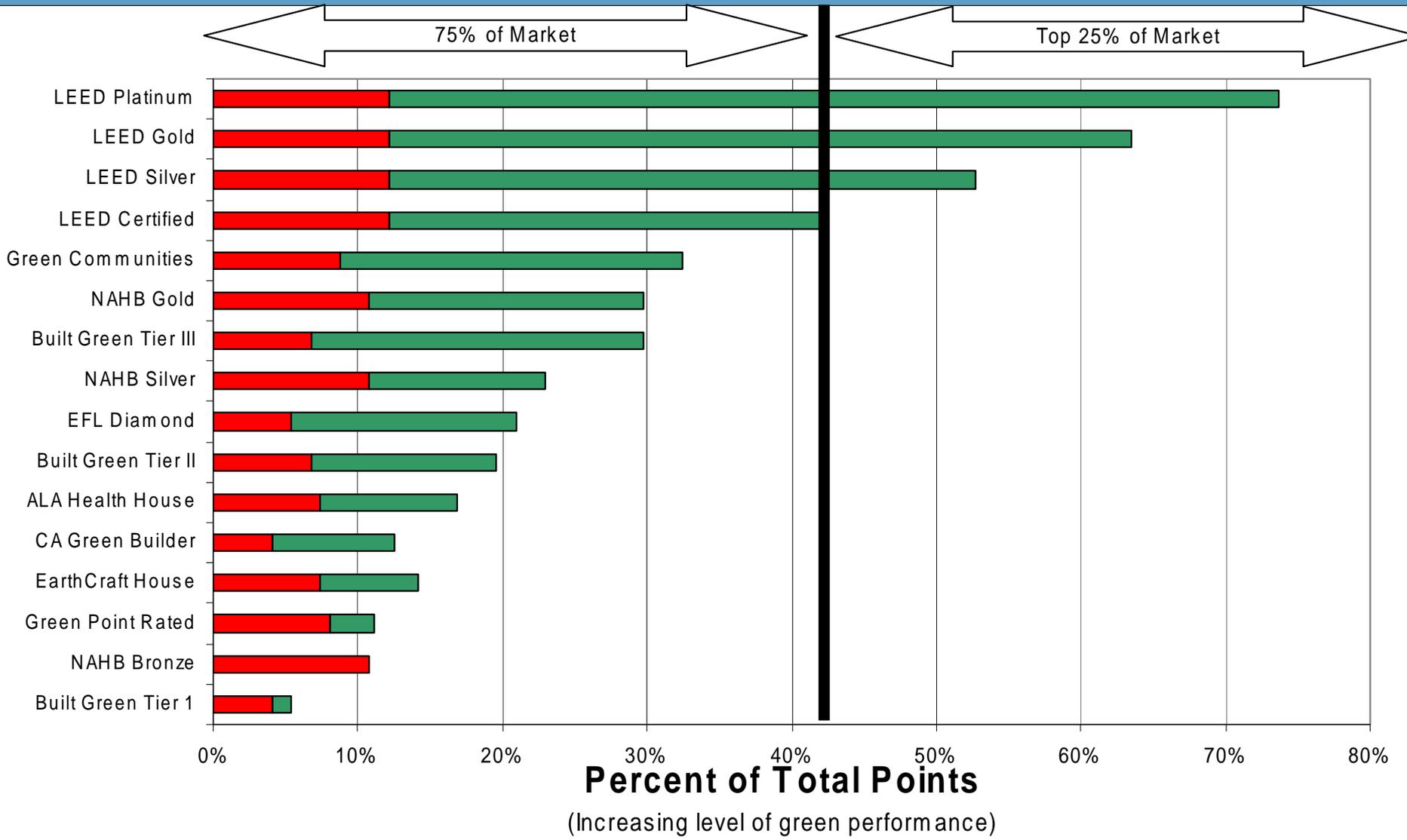
Mandatory	10 pts			
-----------	--------	--	--	--

.....

Total

100 pts	400 pts	100 %	100 %
---------	---------	-------	-------

Comparison of Green Building Rating Systems



Summary

- It is difficult to compare cost of green measures
 - Limited cost and savings data available
 - How to calculate “cost-effectiveness”?
 - Should account for interactions (integrative design)
- It is difficult to compare programs
 - Should be an apples-to-apples comparison



building a sustainable future...



BUILDING A FRAMEWORK FOR HEALTHY HOUSING

How Healthy are National Green Building Programs?

Presented by Jill Breysse, CIH
National Center for Healthy Housing

Background

Increased Consumer Demand for Homes that are:

- Healthier for families
- Better for the environment
- Less expensive to operate



Background, cont'd

New Construction and Rehab help to:

- Prevent moisture intrusion
- Provide easily cleanable surface and systems to reduce tracking of contaminants into home
- Reduce and eliminate entryways for pests
- Provide sufficient ventilation
- Reduce likelihood of injuries
- Reduce exposure to toxins (radon, VOCs, lead)



Purpose of NCHH Report

- Compare Green Programs to core set of Healthy Homes criteria
- Identify programs offering greatest protection of resident health
- Help gov't agencies, builders, architects, and homeowners make informed decisions



NCHH Healthy Housing Criteria

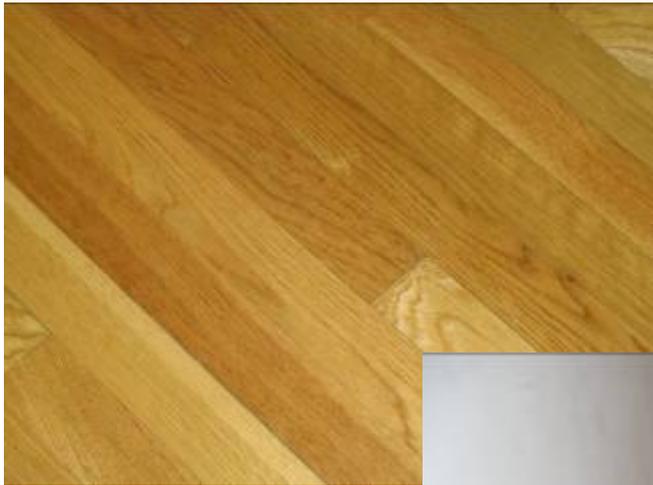
- Dry
- Clean
- Ventilated
- Pest-Free
- Contaminant-Free
- Safe
- Maintained



DRY



CLEAN



Cleanable Floors



Walk-Off Mats



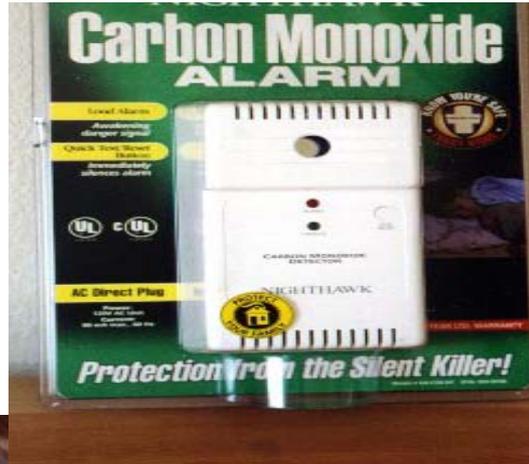
VENTILATED



SAFE



Handrails



CO &
Smoke
Alarms



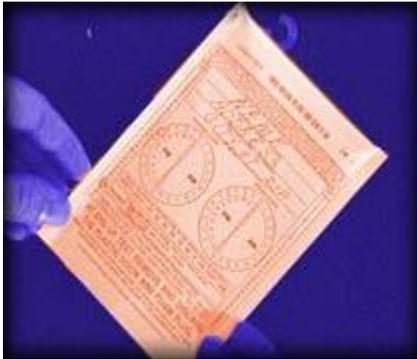
Locking drawers & cabinets



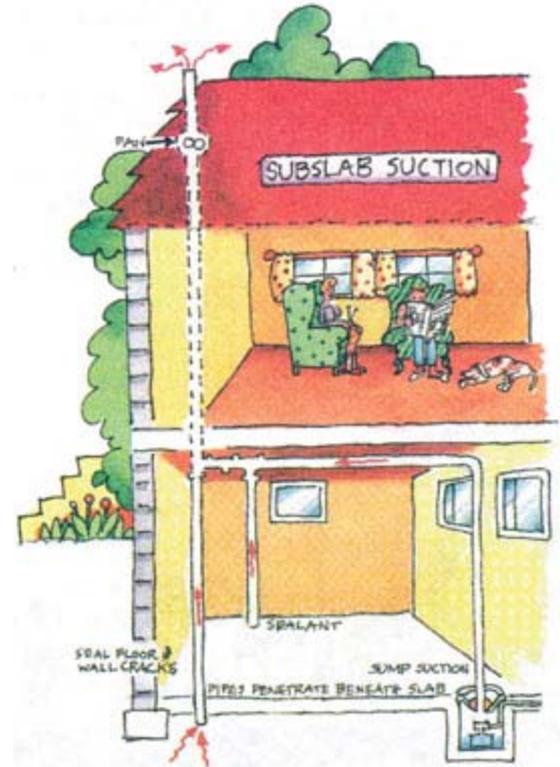
Temperature settings



CONTAMINANT-FREE



Radon
Testing



Radon Mitigation



CONTAMINANT-FREE, continued



ETS



Deteriorated Lead-Based Paint



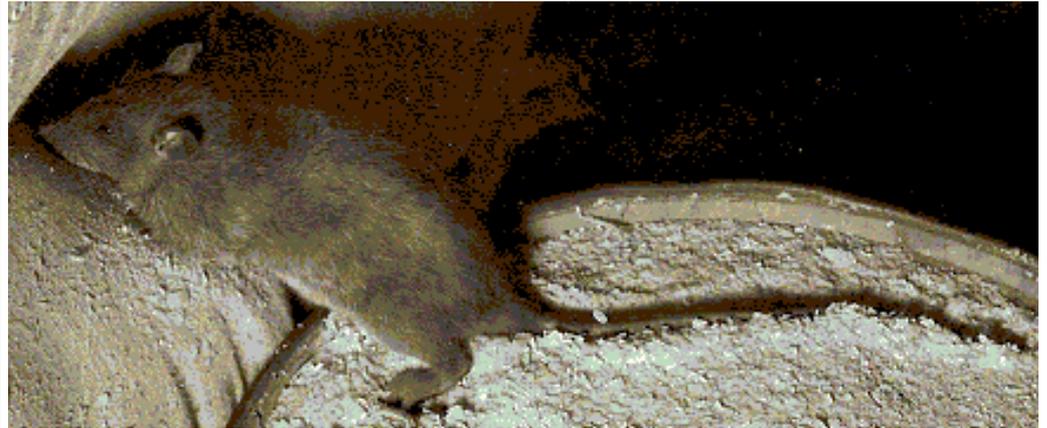
Vented combustion appliances



Low-VOC materials



PEST-FREE



WELL-MAINTAINED



National Center for Healthy Housing
National Healthy Homes Training Center and Network

Healthy Homes Maintenance Checklist

The following checklist was developed for the Healthy Homes Training Center and Network as a tool for healthy home maintenance. A healthy home is one that is constructed, maintained, and rehabilitated in a manner that is conducive to good occupant health.

To maintain a healthy home, occupants should keep it dry, clean, and pest-free, and prevent injury and control chemical contaminants both indoors and outdoors. Good

home maintenance can act to reduce allergens, prevent illness, and reduce injury from accidents. This checklist provides basic guidelines; items may need to be checked more often depending on local conditions and manufacturer suggestions.

Developed by the National Healthy Homes Training Center by Tony Braxton, Contractor Association and Ellen Taha, CR7 Associates.

Spring
Fall
Annual
As Needed
Pro-Neighbor?

Yard & Exterior	Spring	Fall	Annual	As Needed	Pro-Neighbor?
Water drains away from house	✓				
No trip, fall, choking, sharp edge hazards	✓	✓			
Fence around pool intact	✓	✓			
Check for signs of rodents, bats, roaches, termites	✓	✓			
Drain outdoor faucets and hoses		✓			
Clean window wells and check drainage	✓	✓			
Clean gutters and downspouts	✓	✓			

Basement & Crawspaces	Spring	Fall	Annual	As Needed	Pro-Neighbor?
No wet surfaces, puddles	✓	✓			
Sump pump and check valve working	✓	✓			
Floor drain working	✓				
Vacuum basement surfaces	✓				
Check for signs of rodents, bats, roaches, termites		✓			

Spring
Fall
Annual
As Needed
Pro-Neighbor?

Exterior Roof, Walls, Windows - check for leaks	Spring	Fall	Annual	As Needed	Pro-Neighbor?
Shingles in good condition	✓				
Check chimney, valley, plumbing vent, skylight flashing	✓				
Make sure gutters drain water away from building	✓				
Check attic vents		✓			
Check attic for signs of roof leaks	✓				
Check for icicles and ice dams			Winter		
Look for peeling paint, efflorescence	✓				
Look for signs of leaks where deck attaches to house	✓				
Check below window & door that flashing intact	✓				
Repair broken, cracked glass		✓			
Look for signs of leaks at window and door site	✓				
Clean dryer vent	✓	✓			
Check exhaust ducts are clear	✓	✓			

Maintenance Checklist continued on back

Building a lead-safe and healthy home environment for all children • 10257 Skingop Circle, Suite 100, Columbia, MD 21044 • www.nationalhealthyhousing.org



**BUILDING A FRAMEWORK
FOR HEALTHY HOUSING**

Public and Private Sector Building Guidelines

- Enterprise Community Partners
Green Communities Criteria
- USGBC LEED for Homes
- NAHB Green Home Building
Guidelines
- US EPA Energy Star with Indoor Air
Package



Enterprise Community Partners Green Communities Criteria

- Integrated design process
- Site, location, and neighborhood fabric
- Site improvements
- Water conservation
- Energy efficiency
- Materials beneficial to the environment
- Healthy living environment
- Operations and maintenance



US EPA Energy Star with Indoor Air Package (IAP) Pilot Specifications

- Moisture control
- Radon control
- Pest control
- HVAC systems
- Combustion safety
- Building materials
- Home commissioning



USGBC LEED for Homes

- Awareness and education
- Location and linkages
- Energy and atmosphere
- Sustainable sites
- Water efficiency
- Indoor environmental quality
- Materials and resources
- Innovation and design processes



NAHB

- Resource efficiency
- Energy efficiency
- Water efficiency
- Indoor environmental quality
- Ops, maintenance, & homeowner educ.
- Global impact
- Site planning & land development



Method of Analysis-Scoring System

Score	Green Program Description
3	Includes mandatory criterion equivalent to NCHH criterion
2	Includes mandatory criterion similar to NCHH criterion
1	Includes optional criterion that is similar to NCHH criterion
0	Does not include similar criterion



Grading Key

A+	>100% of target score, <i>all</i> NCHH criteria included
A	90-100% of target score
B	80-89% of target score
C	70-79% of target score
D	<70% of target score



Results

	Enterprise Green Commun.	ENERGY STAR Indoor Air Pkg	USGBC LEED Homes	NAHB Green Building Program
Dry (10 criteria-25 pts)	24 (96%)	24 (96%)	22 (88%)	12 (48%)
Clean (2 criteria-5 pts)	1 (20%)	0 (0%)	1 (20%)	1 (20%)
Ventilated (7 criteria-17.5 pts)	17 (97%)	21 (120%)	17 (97%)	8 (46%)
Safe (5 criteria-12.5 pts)	5 (40%)	5 (40%)	5 (40%)	3 (24%)
Contaminant-Free (7 criteria-17.5 pts)	18 (103%)	17 (97%)	10 (57%)	9 (51%)
Pest-Free (1 criterion-2.5 pts)	3 (120%)	3 (120%)	2 (80%)	1 (40%)
Maintained (2 criteria-5 pts)	6 (120%)	5 (100%)	6 (120%)	5 (100%)



National Green Programs Health Grades

Health Principles	Green Communities	Energy Star IAP	USGBC LEED-H	NAHB Green Bldg
DRY	A	A	B	D
CLEAN	D	D	D	D
WELL VENTILATED	A	A+	A	D
SAFE	D	D	D	D
CONTAMINANT-FREE	A	A	D	D
PEST-FREE	A+	A+	B	D
MAINTAINED	A+	A	A+	A
OVERALL GRADE	B+	B+	B-	D+



Conclusions

- All green programs not created equal
- Ventilation & pest mgmt addressed by most programs
- Greater focus needed on safety and cleanability



Recommendations

- **Overall:** More focus on affordable housing
- **Dry:**
 - Landscaping away from building foundations
 - Avoid use of mold-susceptible materials in wet areas
- **Safe:**
 - Lockable chemical storage cabinets
 - Bathroom grab bars
 - Water heater temp 120 degrees
- **Contaminant-Free & Clean:**
 - Active sub-slab depressurization new construction
 - Options for multi-family smoke-free properties
 - Smooth and cleanable flooring & walk-off mats
 - Optional central vacuum
- **Ventilation:** ASHRAE 62.2



Full Report Available at:

http://www.nchh.org/Green_Analysis_2008.pdf

