Improving Performance in Moderate Multifamily Rehabilitation

Energy Design Conference

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What?

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green communities

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FAMILY HOUSING FUND

Minnesota Housing Finance Agency

Enterprise green communities

Moderate Multifamily Rehab: Protocols for Building Performance Upgrades

Minnesota's affordable housing funders and Enterprise Green Communities want to require multifamily rehab projects to implement cost-effective energy efficiency improvements. However, current requirements as

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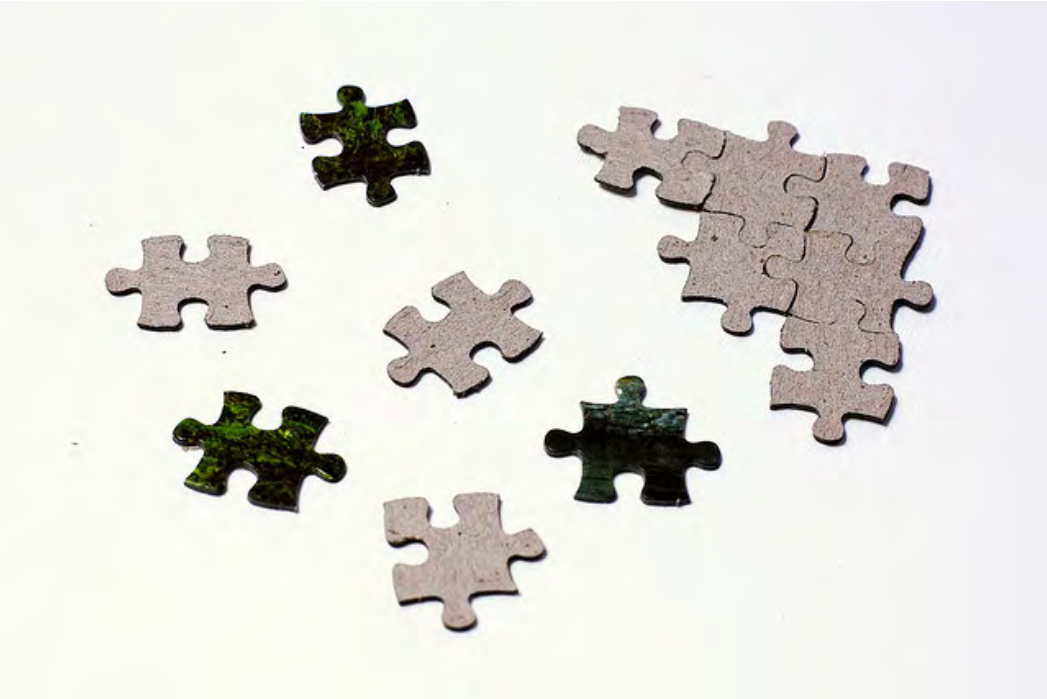
Why? Requirements Unclear

1. Limitations in Implementing Improvements
   - Developer capacity varies widely
2. Auditors Unclear of Requirements
   - Lack of standardization in how to test and what to recommend
3. Minnesota Housing/Minnesota Green Communities Want Good Policy
4. Enterprise Wrestling with Same Issues

Who was Involved?



- Funders/Cities
- Developers
- Designers
- Engineers
- Utilities
- Energy Performance Professionals

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Task Force Goals

Policy to implement low-hanging savings when projects are making improvements or refinancing

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Greater Minnesota Housing Fund

Family Housing Fund

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Task Force Goals

How it helps Minnesota Housing:

- Process applicable to Mod Rehab
- Streamline Mod Rehab Process

Minnesota Housing
2011-2012 Consolidated RFP

Of funded projects:

- 20 were Moderate Rehabilitation Projects (total 53 projects)
- Included 2,176 Residential Units

Task Force Goals

How it helps building evaluators:

- Clear expectations for services
- Certain it meets customer needs

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Minnesota Overlay
Criteria 5.1c (Building Performance, =/< 3 Stories)

Energy Efficiency Improvement Plan (EEIP) Option

- Conduct audit w/blower door test to establish baseline performance levels
- Create and implement plan with technical guidelines from MN Field Guide (Ch.2.1.1)
- Implement improvements with good ROI

Minnesota Overlay
Criteria 5.1c (Building Performance, =/< 3 Stories)

Energy Efficiency Improvement Plan (EEIP) Option

- Remaining equipment w/ Effective Useful Life (EUL) of at least 7 years shall be included in EEIP
- Replaced equipment shall meet DOE ENERGY STAR Builders Option Package (BOP) requirements based on zone

Minnesota Overlay
Criteria 5.1d (Building Performance, =/> 4 Stories)

May 2013 Version

MN Overlay & Guide to the 2011 Enterprise Green Communities Criteria

- Performance equivalent to ASHRAE 90.1-2007 is not required.
- EEIP Strongly Encouraged (use 5.1c process)
- Only Improvements in Scope of Work shall comply with Criteria

Minnesota Overlay
Criteria 5.1d (Building Performance, =/> 4 Stories)

May 2013 Version

MN Overlay & Guide to the 2011 Enterprise Green Communities Criteria

- Equipment with EUL of at least 7 years is recommended to be in the EEIP
- If Equipment is replaced…
  - DOE Energy Star BOP
  - Or, Prescriptive Path of Energy Star Multifamily High Rise (MFHR) Requirements

Process

Drafted exhaustive recommendations by experts

- replacements
- combustion safety

Developed definition of “Cost-Effective”

Case Studies to test recommendations

- Representative, diverse

Early Discussion Themes – Assessment Type

- Should assessment be with or without a blower door? A walk-through visual inspection? ASHRAE Level II? Does it depend on building context?

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Early Discussion Themes – Coordination

- How should energy assessment and recommendations be coordinated with other application assessments (CNAs)?
- Timing – as general scope and budget are set in the financing application; there are limited of predevelopment funds:
  - Should assessment be done before application? After funding is awarded?
  - What type of assessment should be done at which times?

Early Discussion Themes – Budget

- Budgets are very limited, so what are the best assessment options to ensure projects can make good decisions without excessive spending on assessment?

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Early Discussion Themes – Ventilation

- Ventilation is a recurring theme, related to many issues Minnesota Housing addresses.
- This theme emerged during our other conversations, and is a continuing discussion.

Cost-Effectiveness Threshold Recommendation

The primary goal is to demonstrate cost effective (positive or neutral cash flow impact) of energy improvement on the project over the life of the improvement.

The underlying assumption is that most developments are re-capitalized every 15 years.

Cost-Effectiveness Threshold Recommendations

10-year Simple Payback (current Minnesota Housing guideline)

10-year Simple Payback with utility cost escalation

Net Present Value

PLUS Assumption that equipment at the end of its useful life will be identified for replacement in the Capital Needs Assessment/Physical Needs Assessment

Review: Proposed Recommendations

Our recommendations *not* about End of Useful Life

Never in Recommendations:

windows

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Case Study Goals

Testing our first draft: Are the improvements cost-effective investments that should be *added* to projects because they *cover their own cost*?

Therefore: used FULL replacement cost – adding to scope of work, not incremental costs

If it's being replaced, efficient equipment already required

Next Step: Case Studies

1. Complete analysis on each case study
2. Review payback on each measure
3. Identify measures to set aside – not cost-effective
4. Compare with Franklin/ECW report
5. Revise Recommended Prescriptive Path

THEN: Model the Bundles, without measures that were not Cost-Effective Items

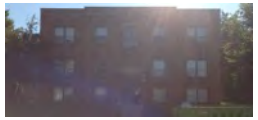
Case Study Projects

Interim Work Group Charge

Focus on the cost implications of the first draft. Recommend updates to ensure they are cost-effective.

- Test the recommendations through application to case studies
- Identify what is cost effective but missing (if anything)

Case Study Projects



Project	Stories	Units	Moderate or Limited	Construction Type	Year Built	Construction Cost
North Meadows	3	36	moderate	stick framed, slab on grade, brick, metal siding and brick	1980	$51k/unit
Seward Square Apts	5	81	moderate	brick exterior, concrete w/ steel studs	1980	$41k/unit
Unity Place	2	112	moderate	townhome, slab on grade, stick framed	1975	$25k/unit
3310 Penn	2	12	limited	brick cladding	1940	$38k/unit
Nobles Square	2	48	moderate	Stick Framed, Vinyl and Brick	1980	$43k/unit

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Case Study Goals

Testing our draft prescriptive path: Are the improvements cost-effective investments that should be *added* to projects because they *cover their own cost*?

Therefore: used FULL replacement cost – adding to scope of work, not incremental costs

If it's being replaced, efficient equipment already required per Green Communities Criteria

Summary of Draft Prescriptive List

- Attic Insulation (to code) and Air Sealing if attic is accessible
- Wall Insulation filling cavity if accessible from exterior
- Replace Heating/AC System with High Efficiency Model
- Heating system control updates
- Refrigerator Replacement to Energy Star model
- Energy Star Lighting upgrades

Illustration of Analysis Process

Analysis Process Overview

Identify Project Pathway (Moderate/Limited Scope)

Identify Building Characteristics

Identify Measures Triggered

Develop Scope of Work, Get Pricing (No Rebates Included)

Model (REM/RATE) Building As-Is for Baseline

- Measure-by-Measure
- Bundle of Triggered Measures

Analyze Usage and Measure Costs to Get Payback (Measure-by-Measure AND Bundle)

Case Study #1

Nobles Square

- 48 DU's
- Construction Cost
  - $2.2 Million, $43K per DU

Triggered Measures:

- Attic Insulation and Air Sealing
- Lighting
- Fridge replacement

Measures Not Triggered:

- Wall Insulation
- Heating system replacements/ tune-ups
- AC replacement

Would be classified as Moderate Rehab under proposed definition.

Sample Report from REM/RATE

Fuel Summary

Property	Organization	HERS
SWMHP		Projected Rating
Worthington, MN	Builder	Rater ID:

Weather:Sioux Falls, SD
2175 Nobles Square - All Scenarios
Building 2175 - All Scenarios.blg

Annual Energy Cost($/yr)	2175 Nobles Square	2175 Nobles Square - All Scenarios	Savings	%Saved
Electric	39315	31971	7345	18.7%
Annual End-Use Cost($/yr)				
Heating	15858	11975	3883	24.5%
Cooling	1592	1084	508	31.9%
Water Heating	7813	7813		
Lights & Appliances	14052	11099	2953	21.0%
Photovoltaics	-0	-0		
Service Charge	0	0		
Total	39315	3197[illegible]	7345	18.7%
Annual End-Use Consumption				
Heating (kWh)	149920	113209	36711	24.5%
Cooling (kWh)	15053	10248	4805	31.9%
Water Heating (kWh)	73711	73711		
Lights & Appliances (kWh)	132566	104705	27861	21.0%
Total (kWh)	371249	301872	69376	18.7%
Annual Energy Demands(kW)				
Heating	93.1	69.3	23.8	25.6%
Cooling	18.2	13.3	4.9	26.9%
Water Heating (Winter Peak)	13.6	13.6		
Water Heating (Summer Peak)	10.5	10.5		
Lights & Appliances (Winter Peak)	11.3	8.1	3.2	28.0%
Lights & Appliances (Summer Peak)	24.3	19.1	5.3	21.7%
Total Winter Peak	118.0	91.1	27.0	22.8%
Total Summer Peak	53.1	42.9	10.2	19.2%

Using Payback Calculator

Assumptions

30	years	(up to 1000 years)
5%	discount rate	
$ 0.72	therm	
$ 0.11	kWh	
4%	energy cost escalation rate	
$0	loan downpayment	
6%	loan interest rate	
30	loan length in years	
1	loan comparison year	

	ENERGY USE - Electricity (in kWh)	ENERGY USE - Natural Gas (in therms)	ENERGY COST RATE (initial)	ENERGY SAVINGS RATE (initial)	ADDITIONAL UP FRONT COST	SIMPLE PAYBACK (years)	SIMPLE PAYBACK (with energy cost escalation) - a value of 1001 never pays back	NPV PAYBACK (with energy cost escalation) - a value of 1001 never pays back
North Meadows Pre-Work	83446	8921	$ 15,295		$ -			
Attic Insulation and air sealing (20% reduction	83692	8326	$ 14,891	$ 404	$ 5,271	13	11	14
Replace Heating System w/85%AFUE Boiler and 90%AFUE Forced Air Furnace (Common)	83335	8012	$ 14,626	$ 669	$ 53,500	74	36	129
Replace Window A/C Units to Energy Star median	79490	8921	$ 14,876	$ 419	$ 11,700	27	19	31
Replace Refrigerators w/Energy Star Median Model	77287	9068	$ 14,749	$ 547	$ 12,240	21	16	24
Energy Star lighting upgrade (100% cfls) @ $30/bulb	70671	9228	$ 14,163	$ 1,132	$ 13,800	12	10	13
Bundle	61173	7818	$ 12,137	$ 3,158	$ 94,331	30	21	36

Model Results Example
Nobles Square

Energy Conservation Measure	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)
Insulation and Air Sealing	6	6	7
Wall Insulation	N/A	N/A	N/A
Replace Thermostatic baseboard/radiator control valves (TRV)	N/A	N/A	N/A
Replace Steam traps in excess of 13 years (steam systems)	N/A	N/A	N/A
Heating System Tune-up	N/A	N/A	N/A
Replace heating system	N/A	N/A	N/A
Replace A/C units with Energy Star model	N/A	N/A	N/A
Energy Star fridge replacemtents	23	17	26
Upgrade to energy star lighting	5	5	6
Bundle	8	8	9

Model Results Example
Nobles Square

Nobles Square Package	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)
Including Post Construction Assessment Costs	8	8	9

($1,627.67 first cost/unit)
($192 savings/unit/year)

Back to the big picture

Completed analysis on each case study

Reviewed payback on each measure

Identified measures to set aside – not cost-effective

Compared with MN DOC CARD study —*MN Multifamily Rental Characterization Study (ECW & Franklin Energy)*

Revised Recommended Prescriptive Path

THEN: Modeled the Bundles, without measures that were not Cost-Effective Items

Measure Example 1

Lighting: met expectations as cost-effective

	Nobles Square			North Meadows			3310 Penn			Unity Place			MN CARD Study
Energy Conservation Measure	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE
Upgrade to energy star lighting	5	5	6	12	10	13	5	5	5	2	2	2	1-3.4

Measure Example 2

Refrigerators: did not meet expectations, not cost-effective

	Nobles Square			North Meadows			3310 Penn			Unity Place			MN CARD Study
Energy Conservation Measure	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE
Energy Star fridge Replacements	23	17	26	21	16	24	23	17	26	19	15	21	

Measure Example 3

Difficult: Attic Insulation/Air sealing unclear whether cost-effective

	Nobles Square			North Meadows			3310 Penn			Unity Place			MN CARD Study
Energy Conservation Measure	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE
Insulation and Air Sealing	6	6	7	13	11	14	N/A	N/A	N/A	20	15	23	

Measure Example 4

Difficult: No data to determine whether cost-effective

	Nobles Square			North Meadows			3310 Penn			Unity Place			MN CARD Study
Energy Conservation Measure	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE	SIMPLE (escalation)	NPV	SIMPLE
Replace Thermostatic baseboard/ radiator control valves (TRV)	N/A	N/A	N/A							N/A	N/A	N/A	
Replace Steam traps in excess of 13 years (steam systems)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Cost-Effectiveness Threshold Recommendations

Cost-Effectiveness Threshold Recommendations

The primary goal is to demonstrate cost effective (positive or neutral cash flow impact) of energy improvement on the project over the life of the improvement.

The underlying assumption is that most developments are re-capitalized every 15 years.

Cost-Effectiveness Threshold Recommendations

10-year Simple Payback (current Minnesota Housing guideline)

10-year Simple Payback with utility cost escalation

Net Present Value

PLUS Assumption equipment at the end of its useful life will be identified for replacement in the Capital Needs Assessment/Physical Needs Assessment

Cost-effectiveness Analysis Outcomes

Cost-Effective	Not Cost-Effective	Difficult
Lighting	Refrigerator Replacement	Attic Air Sealing and Insulation—developed extra models
Less Than 10 Year Payback CARD Grant Items: •Water Efficiency Measures •Boiler Control Items •Heating System Tune-up •Boiler Pipe Insulation	Heating System Replacement	Wall Insulation—developed extra models
	A/C Unit Replacements	Measures with No Modeling/ No CARD Data

Small Group Discussions/Working Group proposals

- We broke into small groups to discuss the "Difficult" measures
- Some things needed further discussion—small working groups were formed to draft proposals
- Outcomes of this work went into drafting the most recent Prescriptive list
- Re-ran bundled payback for new prescriptive list

Bundle Payback for all Case Studies

	Nobles Square			North Meadows			3310 Penn			Unity Place		
Bundle	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)
Current Draft Path Bundle	8	8	9	30	21	36	11	10	12	22	17	25
Recommended Path Bundle*	5	5	6	12	10	13	5	5	5	10	9	11

*We used R30 existing attic insulation as the trigger threshold, and empty walls as the wall trigger threshold.

Resulting Prescriptive Pathway

- Through-wall air conditioners: Install insulated covers.
- Insulate Ventilated Accessible Attic Space in electrically heated properties with existing insulation below code, in gas-heated properties if existing insulation is <R30
- Insulate and Air Seal HVAC ductwork carrying conditioned air in any pitched roof attic.
- Insulate exterior walls with a wall cavity 3.5” or greater AND no existing insulation: Masonry exterior with occupied units is excluded from this requirement.
- Heating system tune-up for remaining heating equipment
- Equipment or systems listed below must be upgraded to meet Green Communities Criteria standards.
  - Hot water boiler system: install outdoor air reset controls to automatically adjust supply water temperature
  - Exposed boiler pipes: insulate
- Upgrade Lighting to Energy Star standards
- Install Water Saving

**All new equipment will follow Green Communities efficiency thresholds upon replacement

Health and Safety Items (All Pathways)

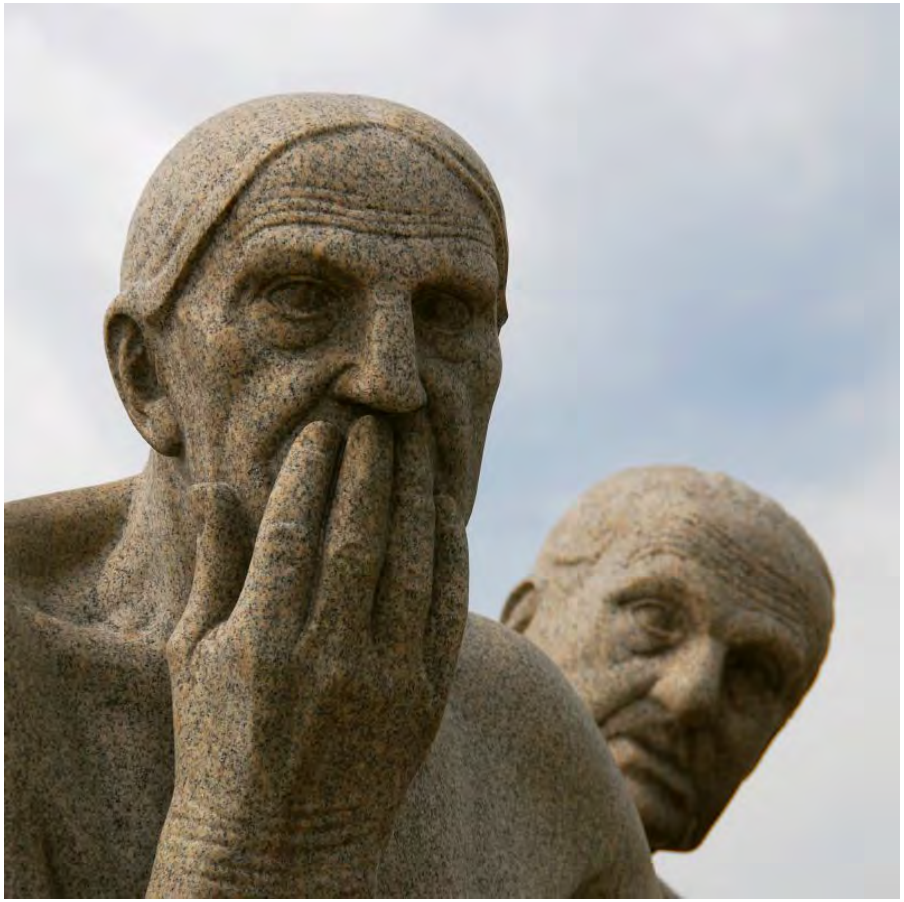
- Required Combustion Safety testing at close of all projects
- All natural drafting water heaters in units will be replaced with power vented water heaters
- Ventilation standards must be met to follow industry standards and code requirements
- Some items on prescriptive list require post testing/inspection

Moving to Policy

Policy-Maker Response

Themes that came up:

- **Limited Scope**
- **Combustion Safety**
- **Ventilation**



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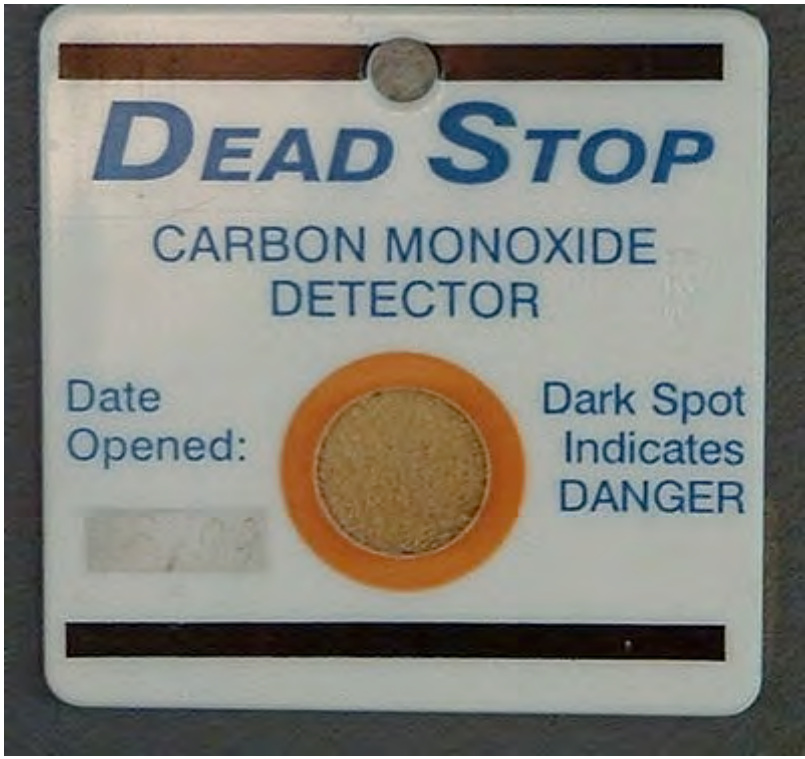
Combustion Safety

Placed up front, clear.

Priority on safety.

Planned replacement part of scope.



Cost of not addressing it up front significantly greater.

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Ventilation

Challenging and expensive.

- Variable cost.
- Less consensus/more confusion on value of upgrades.

Take-Aways

Thresholds set in Cost-Effective definition and the calculator "arbitrary"

- Fit our context
  - Based on Minnesota Housing policy
  - Based on financing structures
- Won't fit other contexts

	Nobles Square			North Meadows			3310 Penn			Unity Place		
Bundle	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)	SIMPLE PAYBACK	SIMPLE PAYBACK (with energy cost escalation)	NPV PAYBACK (with energy cost escalation)
Current Draft Path Bundle	8	8	9	30	21	36	11	10	12	22	17	25
Recommended Path Bundle*	5	5	6	12	10	13	5	5	5	10	9	11

Take-Aways

We used modeling as a way to evaluate cost-effectiveness.

- There are issues with modeling – we used the tools we had.
- We would have preferred to use actual implementation data to calibrate the model.

Take-Aways

Policy context is critical

- Why are people are at the table?
- We started in response to requests from different stakeholders for a more clear and more affordable process.

Take-Aways

Important to keep the performance path

- In some cases the assessment makes the most sense.

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Take-Aways

Process is critical.

- Diverse people in room resulted in broad input.
- Opportunity for important conversations in an abstract context rather than in a project-critical setting.
- Other goals were building:
  - Stakeholder capacity
  - Stakeholder understanding of big picture
  - Buy-in

Questions?


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