State of Oregon
Department of
Environmental
Quality

A Life Cycle Assessment Based Approach to Prioritizing Methods of Preventing Waste from Residential Building Construction, Remodeling, and Demolition in the State of Oregon

Appendix 2: Report Cards

Prepared for DEQ by Quantis, Earth Advantage, and Oregon Home Builders Association

October 13, 2009
09-LQ-107

Intermediate Framing *Practice #1*

Description of Waste Prevention Practice

While the Standard Home was designed to represent a traditional framing approach, many builders already incorporate framing practices that reduce framing members not strictly required for structural purposes. Much of this additional wood framing serves to support interior gypsum board, sometimes called "nailers". Intermediate framing eliminates many nailers in exterior corners and re-orients others to provide proper support for gypsum board. This eliminates uninsulated areas of exterior walls and reduces the amount of lumber used.

Description of Stage I Modeling

The inventory of housing materials is adjusted based on the modeling of OHBA. Energy use is adjusted based on REM/RATE modeling with the revised results from OHBA.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	D	A

Summary of Findings

The primary climate change benefit is from energy efficiency during the use of the home, with smaller additional benefits in reduced materials. Waste prevention benefits are comparatively small and occur mostly at post-occupancy.

Recommended Actions

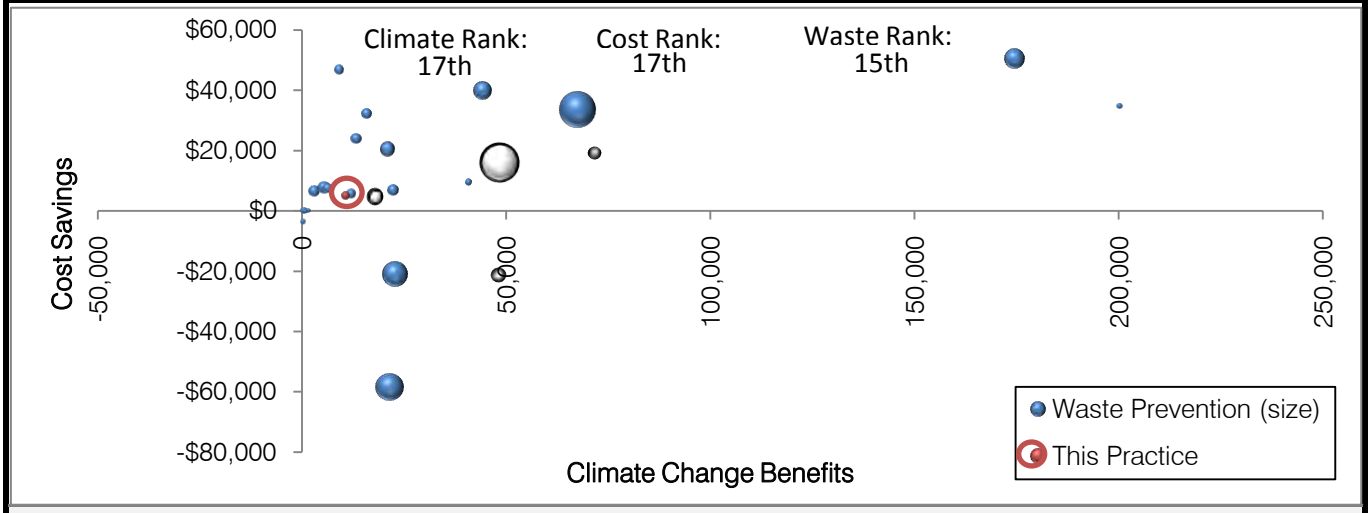
Consider for Phase II as part of a larger evaluation on framing options

Feasibility

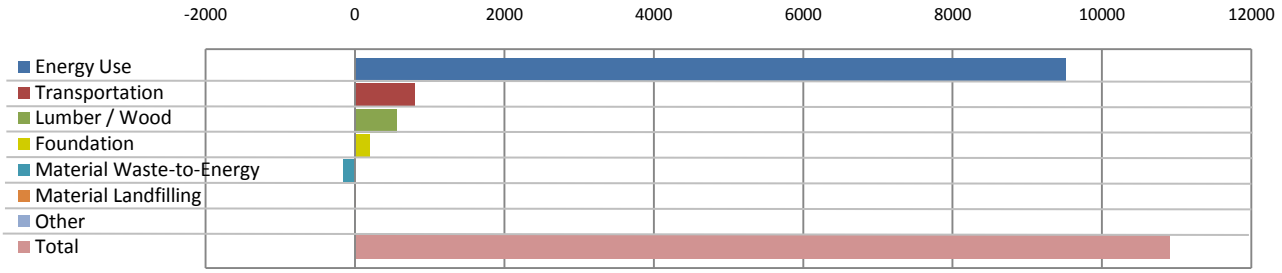
Difficulty to implement	Already common practice		
Acceptability to homeowner	No perceived difference; higher efficiency		
Acceptability to builder	Already common practice		
Potential market penetration	No limitations for wood frames home		
Applicable to multi-family	Only if wood framed		
Applicable to new construction	Yes	*Applicable to existing homes*	Yes
Other comments	0		

Intermediate Framing *Practice #1*

Environmental Impacts, Costs and Waste Prevention

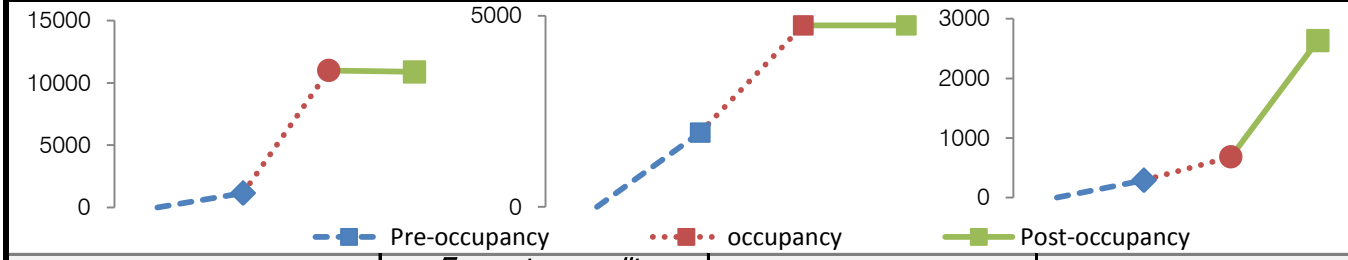


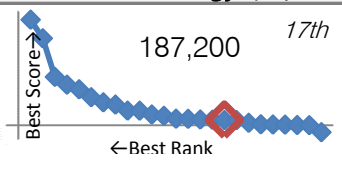
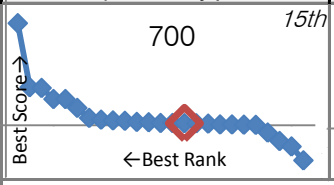
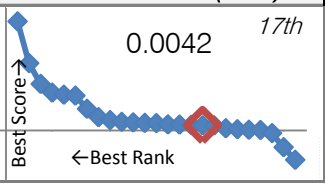
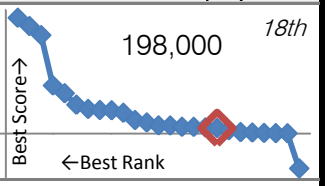
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			
187,200 *17th*	700 *15th*	0.0042 *17th*	198,000 *18th*
Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank

Comments and uncertainties

Advanced Floor Framing *Practice #2*

Description of Waste Prevention Practice

This practices uses the wall framing methods from Intermediate Framing, but adds an advanced floor framing system using I-beams and engineered wood.

Description of Stage I Modeling

The inventory of housing materials is adjusted based on the modeling of OHBA. Energy use is adjusted based on REM/RATE modeling with the revised results from OHBA.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	C	A

Summary of Findings

The primary climate change benefit is from energy efficiency during the use of the home, with smaller additional benefits in reduced materials. Waste prevention benefits are comparatively small and occur mostly at post-occupancy.

Recommended Actions

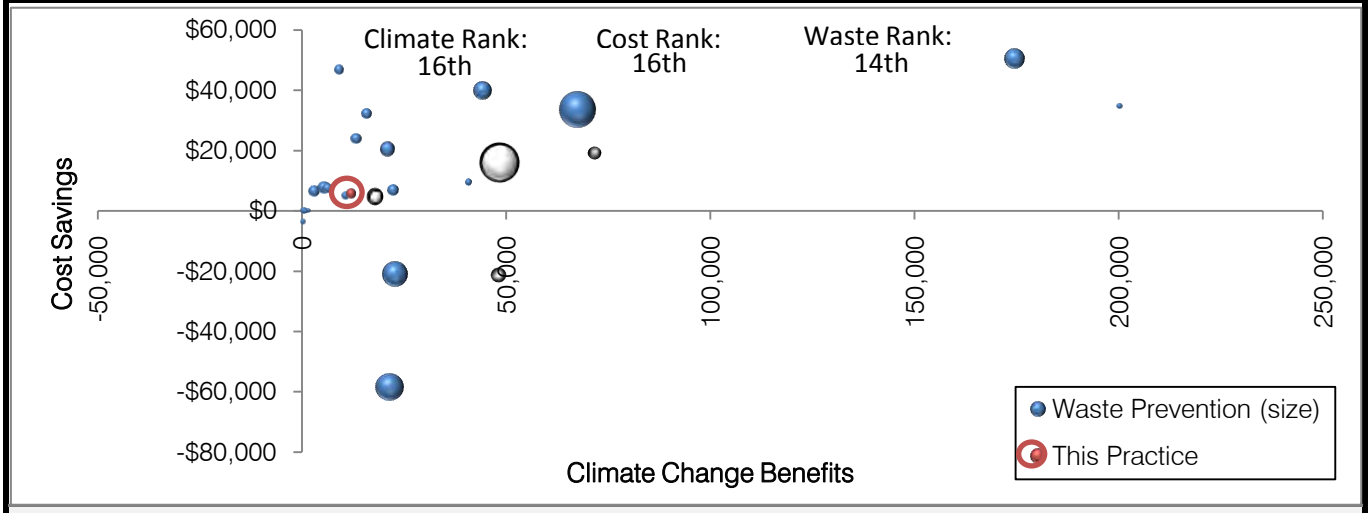
Consider for Phase II as part of a larger evaluation on framing options

Feasibility

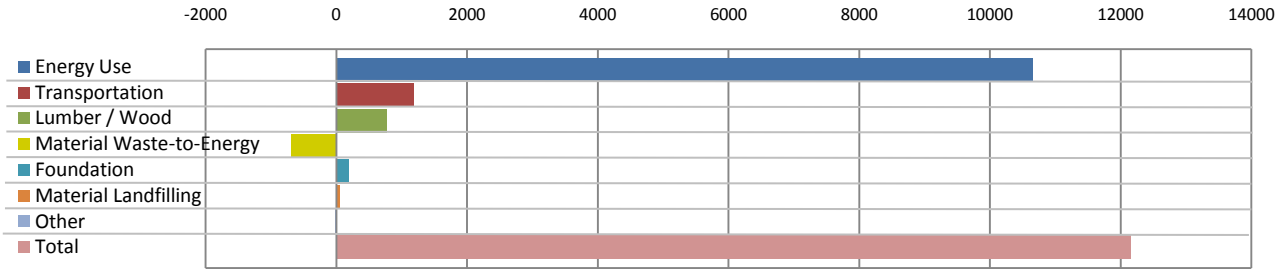
Difficulty to implement	Already common practice		
Acceptability to homeowner	No perceived difference; higher efficiency		
Acceptability to builder	Already common practice		
Potential market penetration	No limitations for wood frames home		
Applicable to multi-family	Only if wood framed		
Applicable to new construction	Equally	*Applicable to existing homes*	Equally
Other comments	0		

Advanced Floor Framing *Practice #2*

Environmental Impacts, Costs and Waste Prevention

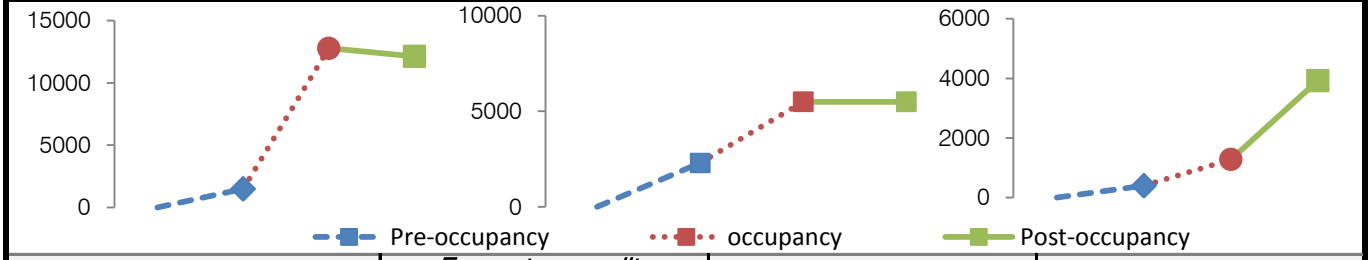


Climate Change Benefits by Category

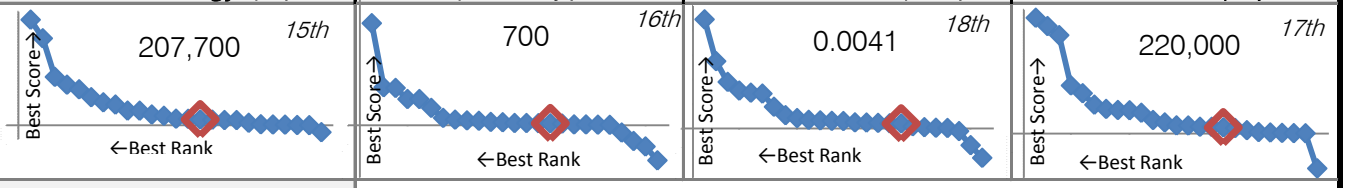


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
207,700 *15th*	700 *16th*	0.0041 *18th*	220,000 *17th*



Comments and uncertainties

Advanced Framing (w/ drywall clips) *Practice #3*

Description of Waste Prevention Practice

There are many variations in what is considered "advanced framing." In the present case, it has been represented as including: 24 inches on center studs; aligning roof trusses with wall studs to allow for the use of single top plate and the efficient transfer of loads; two stud corners; window openings that have one side on module; use of king, header support and cripple within window and door framing only as needed; and eliminating headers in closets and doors that aren't in load bearing walls. Additionally, advanced framing has the potential to reduce the environmental impacts of heating and cooling a home. More spacing between studs allows more insulation and fewer opportunities for thermal bridging.
Dry wall clips are small pieces of hardware that function as structural backing / fastening for drywall. Drywall clips and stops can save wood and reduce labor. They are implemented here on top of the advanced framing option. It is assumed that partition wall intersections have one stud and eight drywall clips.

Description of Stage I Modeling

The inventory of housing materials is adjusted from those in the Standard Home. Energy use is adjusted based on REM/RATE modeling with the revised results from OHBA.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	B	A

Summary of Findings

The primary climate change benefit is from energy efficiency during the use of the home, with smaller additional benefits in reduced materials. Both environmental performance and waste prevention are much improved over the intermediate framing options.

Recommended Actions

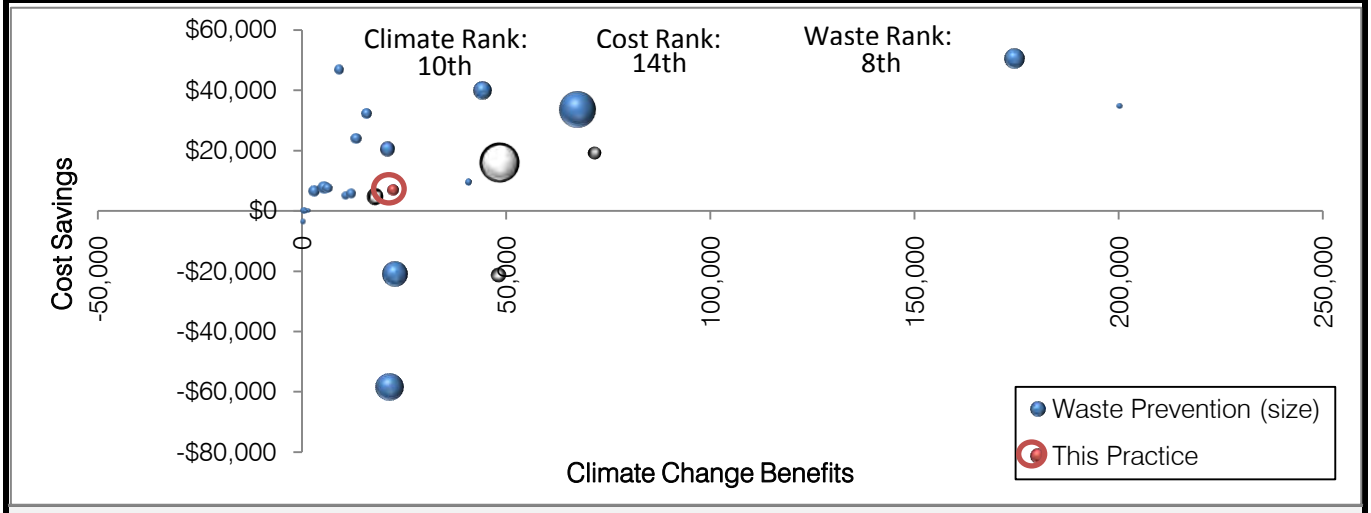
Advance to Phase II

Feasibility

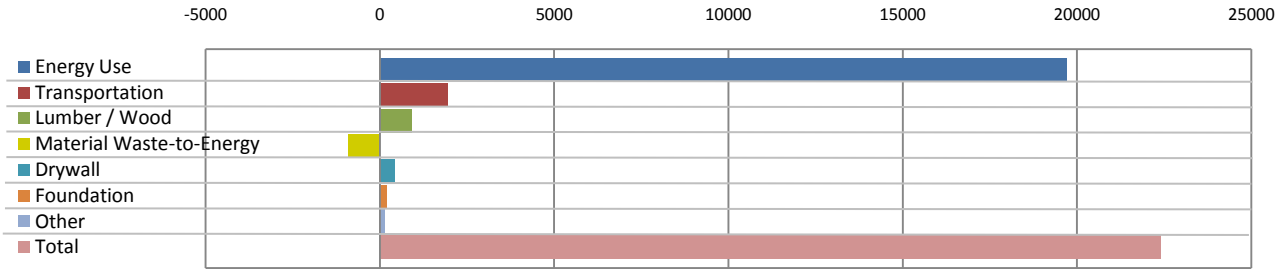
Difficulty to implement	Additional design time unless standardized		
Acceptability to homeowner	Concerns over quality.		
Acceptability to builder	Concerns over quality. Requires outreach and education		
Potential market penetration	No limitations for wood frames home		
Applicable to multi-family	Only if wood framed, not applicable above 3 stories (depending on studs and design requirements/engineering).		
Applicable to new construction	Yes	*Applicable to existing homes*	Yes
Other comments	0		

Advanced Framing (w/ drywall clips) *Practice #3*

Environmental Impacts, Costs and Waste Prevention

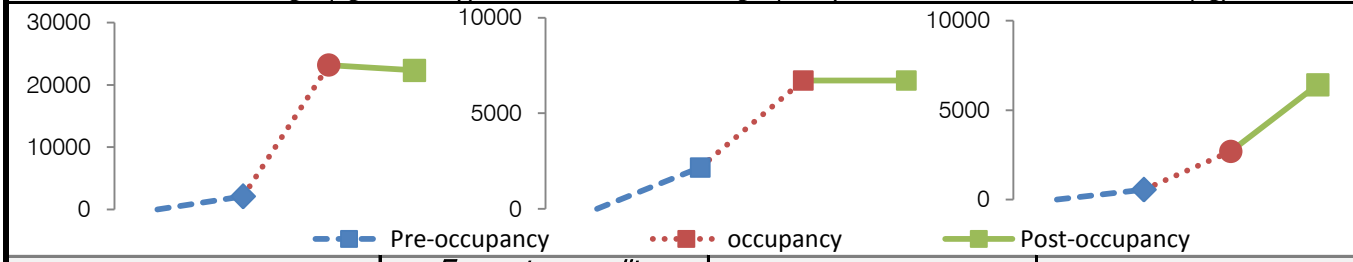


Climate Change Benefits by Category

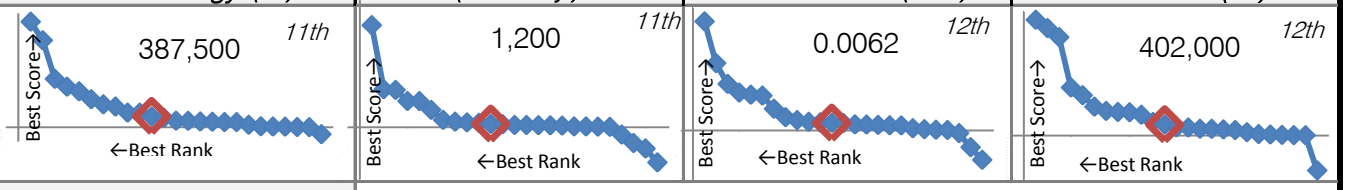


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
387,500 *11th*	1,200 *11th*	0.0062 *12th*	402,000 *12th*



Comments and uncertainties

Detailed Framing Cut List *Practice #4*

Description of Waste Prevention Practice

Construction projects often order more lumber than needed for a project. This can result in unnecessary wood waste. A detailed assessment of framing requirements can help prevent waste. Projects that explicitly document where framing materials are to be used can reduce waste. Detailed framing documents accompanied by a detailed cut list of the ordered lumber allows for the efficient use of resources.

Description of Stage I Modeling

The amount of materials wasted during construction is reduced for those materials able to be affected by a detailed materials list.

Environment Grade	Waste Prevention Grade	Feasibility Grade
D	C	B

Summary of Findings

Benefits from reduced transportation and production of materials (mostly lumber) are offset by the loss of benefits from converting lumber to energy at the end of its life. Both the environmental benefits and the waste prevention benefits are moderate-to-poor in comparison with the other practices.

Recommended Actions

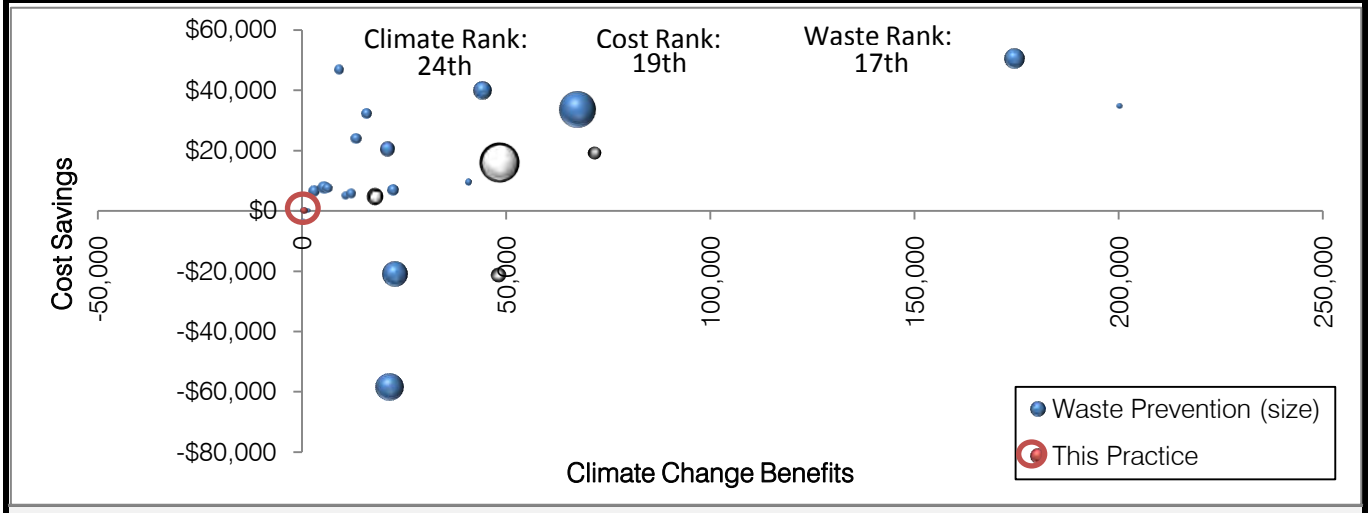
Do not advance to Phase II

Feasibility

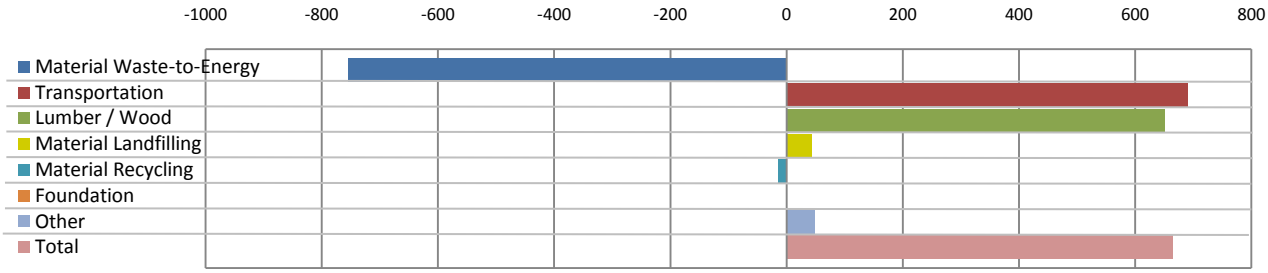
Difficulty to implement	Requires time and training for builders		
Acceptability to homeowner	No perceived difference		
Acceptability to builder	Mixed; recognition of advantages but concerns over time constraints		
Potential market penetration	No limitations		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Applicable to large modifications
Other comments	0		

Detailed Framing Cut List *Practice #4*

Environmental Impacts, Costs and Waste Prevention

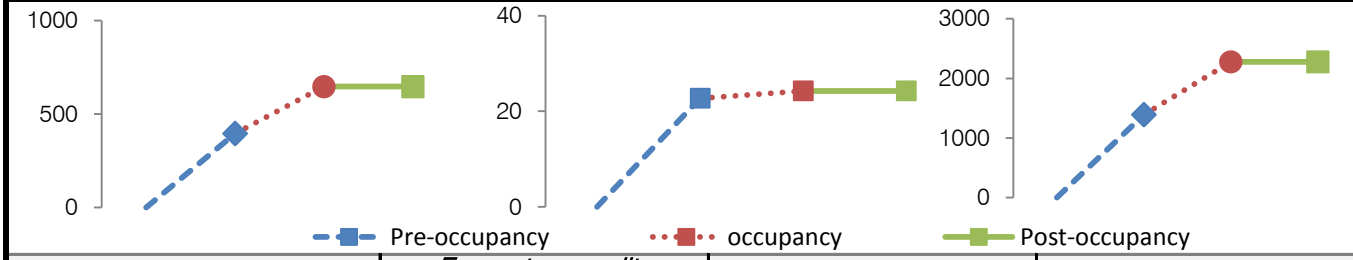


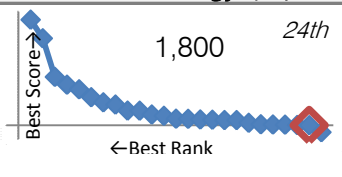
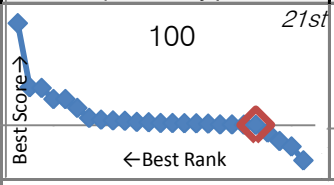
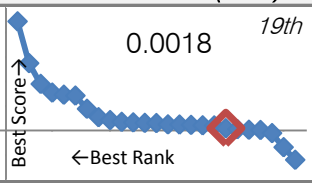
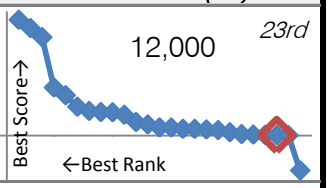
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			

Comments and uncertainties

Off-site Pre-fabricated Components *Practice #5*

Description of Waste Prevention Practice

Roof trusses and various wall types can all be constructed off site and hauled to the construction site. These practices have been shown to reduce construction waste and reduce the amount of time needed to build a home. Additionally, on-site construction in the Pacific Northwest can often face moisture challenges during the rainy season. Off-site fabrication can reduce potential waste of moldy and rotted wood associated with both storing and building with wood in the outdoors.

Description of Stage I Modeling

Material waste for lumber components is reduced to 5%, construction activities are reduced by half, failure due to poor installation is reduced by half and all lumber is assumed to be green rather than kiln dried.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	D	B

Summary of Findings

Reduced construction activity results in a significant environmental benefit. In addition, reduced failure due to improper installation and reduced waste at manufacture provide additional benefits. In total, the benefits are in a moderate range in comparison to other practices. Waste and cost benefits are also in a moderate range.

Recommended Actions

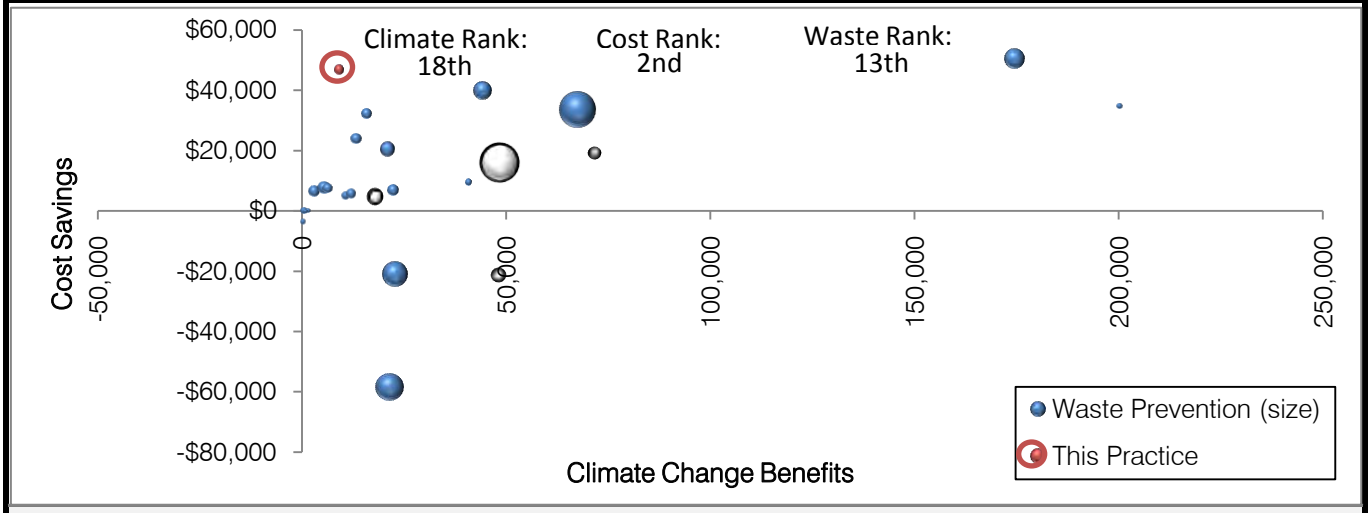
Consider for advancing to Phase 2

Feasibility

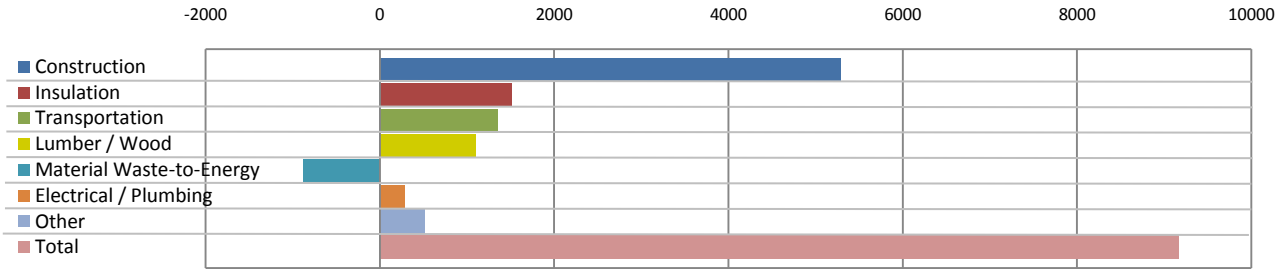
Difficulty to implement	Limited availability of pre-fab components; possible cost increases		
Acceptability to homeowner	No perceived difference, excepting higher cost		
Acceptability to builder	Potential time saver, but higher material cost		
Potential market penetration	No limitations; already high penetration outside of the Northwest		
Applicable to multi-family	Equally, possibly more		
Applicable to new construction	Equally	*Applicable to existing homes*	Very limited applicability
Other comments	There is a potential for more energy/fuel consumption in the manufacture and less worker commuting. A detailed comparison would be needed.		

Off-site Pre-fabricated Components *Practice #5*

Environmental Impacts, Costs and Waste Prevention

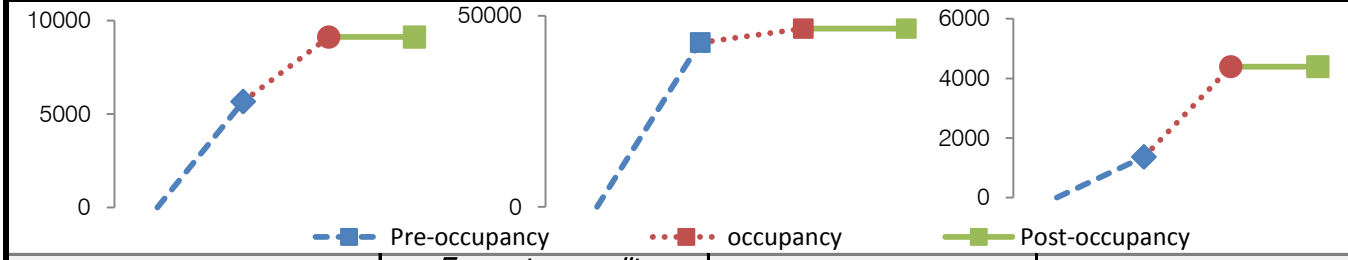


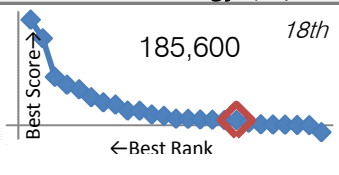
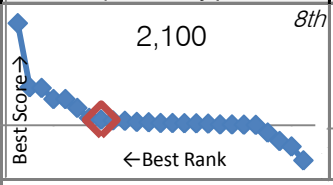
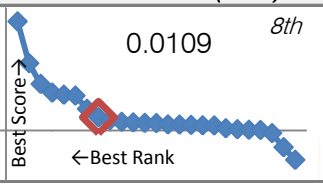
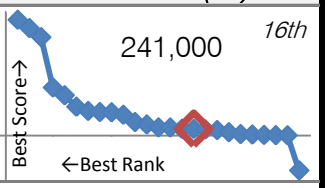
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			
185,600 *18th*	2,100 *8th*	0.0109 *8th*	241,000 *16th*
Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank

Comments and uncertainties

Adaptability: Design for Disassembly *Practice #6*

Description of Waste Prevention Practice

Design for adaptability allows houses to be designed and constructed for both reuse and changes in the occupant's needs. This approach is intended to reduce new materials consumption and waste in construction, renovation, and demolition of buildings. Residential homes today use many adhesives in the construction process, which can make the disassembly and reuse of materials difficult. Some key principles of designing for disassembly are: using high quality materials that can retain value and reuse potential; use bolted, screwed or nailed connections; separate the mechanical, electrical, and plumbing systems for easy repair and replacement access; design using simple open plans that allow for a changes in residential homes; and, use standard dimensions and modularity to facilitate reuse. This scenario is intended to represent an increased use of materials at their end of life.

Description of Stage I Modeling

Materials are represented as in standard home. However, material recovery rates are increased beyond those able to be achieved by Deconstruction. For salvaged materials, a credit is given at end-of-life equal to the production of the original materials.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	A	C

Summary of Findings

The environmental benefit of reusing materials of the home are offset slightly by a decrease in other beneficial uses. However, they are significant enough for this to be a high scoring practice in environmental benefits. It is the second best-scoring practice in waste prevention benefits.

Recommended Actions

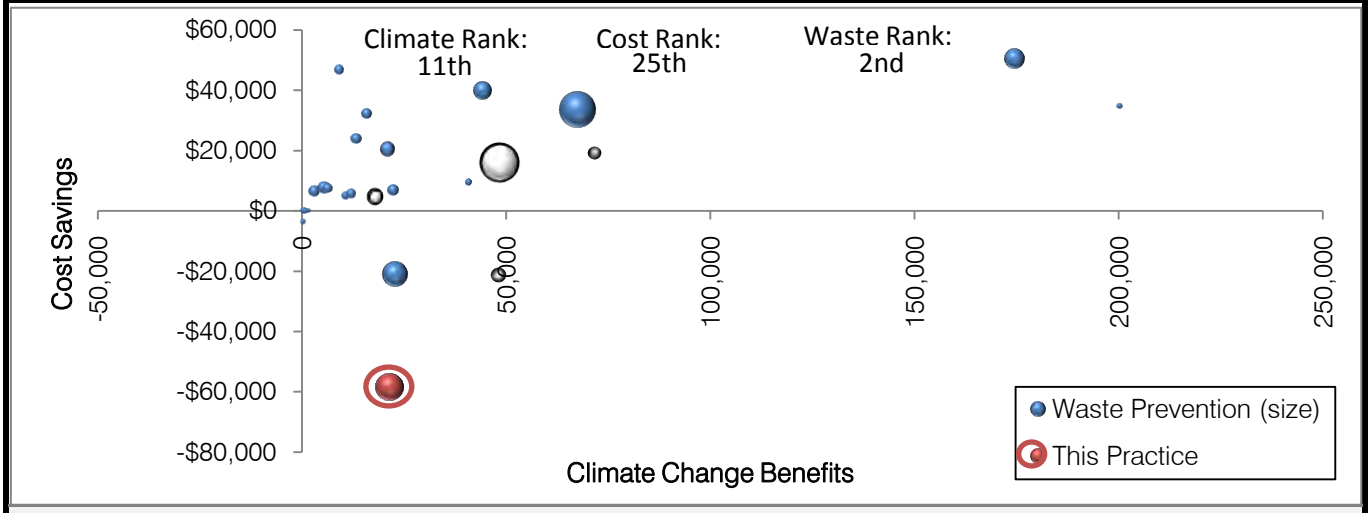
Advance to Phase II, perhaps as part of a larger Adaptability scenario

Feasibility

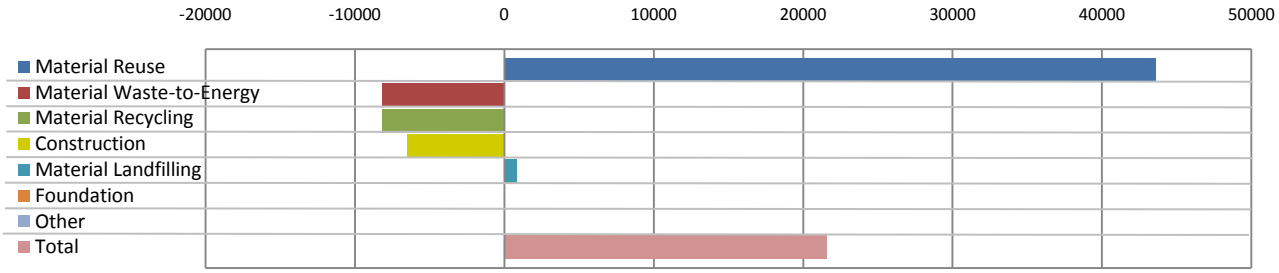
Difficulty to implement	Many products are designed for use of adhesives; code may specify nails or adhesives and not allow for screws/bolts; interior walls would be more able to be designed for disassembly.		
Acceptability to homeowner	Homeowners may prefer to have adaptable home. However, added costs could be prohibitive for many homeowners.		
Acceptability to builder	Mixed; will require different equipment, techniques, more time.		
Potential market penetration	Limited in structural sheer design, and added cost may limit adoption.		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Very limited applicability
Other comments	0		

Adaptability: Design for Disassembly *Practice #6*

Environmental Impacts, Costs and Waste Prevention

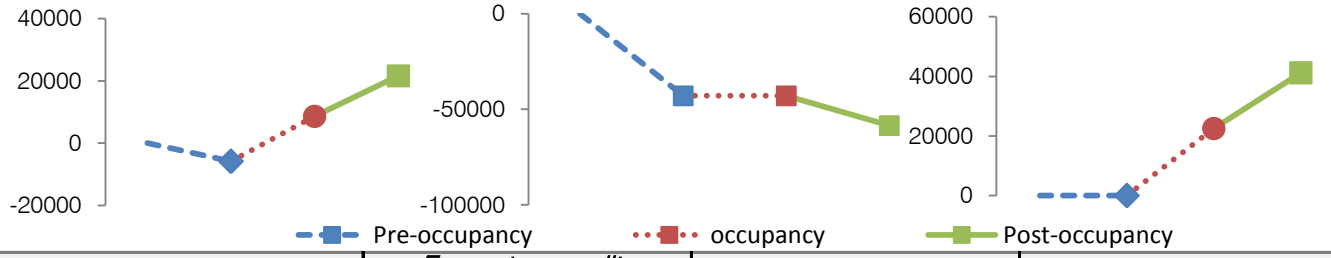


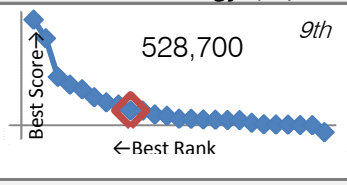
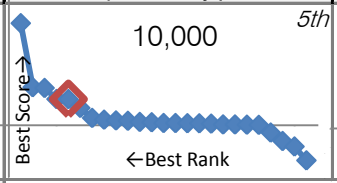
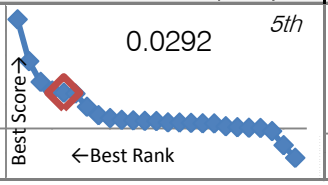
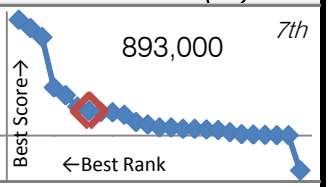
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			
528,700 *9th*	10,000 *5th*	0.0292 *5th*	893,000 *7th*

Comments and uncertainties	Applying an allocation factor of 50% to the credit given at end-of-life would result in a significant reduction in the environmental benefits. The approach taken assumes there is no impact for materials that are passed on to another use.

Adaptability: Utility Chase *Practice #7*

Description of Waste Prevention Practice

Design for adaptability allows houses to be designed and constructed for both reuse and changes in the occupant's needs. This scenario of adaptibility considers the creation of a utility chase that will house the the mechanical, electrical, and plumbing systems for easy repair and replacement access, prevening the need for opening walls and other structural changes. Movement of the ducts to within the conditioned space as part of a utility chase may also result in a shorter ducting distance, saving ducting materials, eliminate the need for insulation materials and reduce heating or cooling losses. This scenario is intended to represent these benefits.

Description of Stage I Modeling

Revised energy use estimates have been created in REM/Rate to reflect the ducts being within conditioned space. Modifications to the home structure to allow for the utility chase have been made in the OHBA model.

Environment Grade	Waste Prevention Grade	Feasibility Grade
B	D	A

Summary of Findings

Moving ducts into the conditioned space results in a significant environmental benefit due to lower energy use.

Recommended Actions

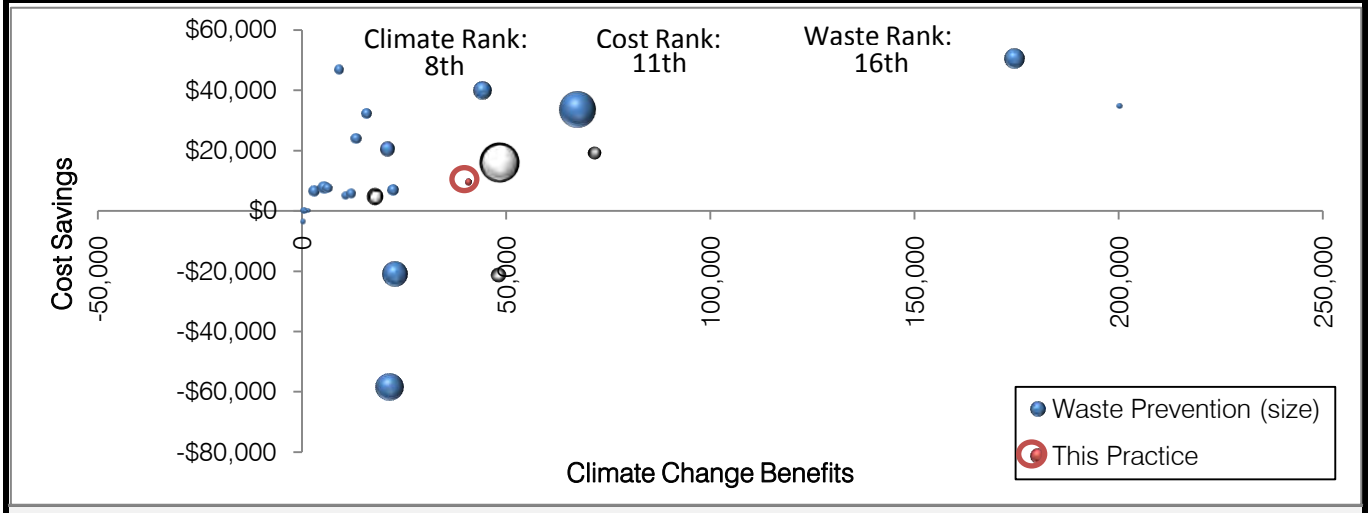
Consider for Phase II as part of an Adaptability scenario

Feasibility

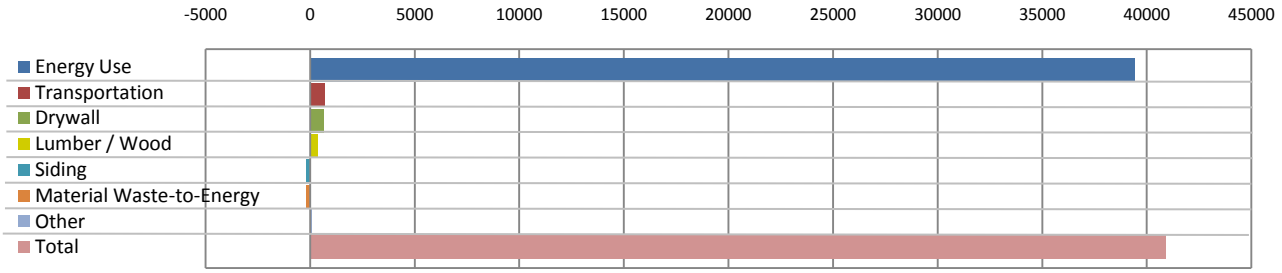
Difficulty to implement	May be difficult in a small number of home designs		
Acceptability to homeowner	Highly acceptable; preferred if it results in a noticeable efficiency gain		
Acceptability to builder	Highly acceptable		
Potential market penetration	Complete penetration possible		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	***Applicable to existing homes***	Limited to significant renovations / additions
Other comments	0		

Adaptability: Utility Chase *Practice #7*

Environmental Impacts, Costs and Waste Prevention

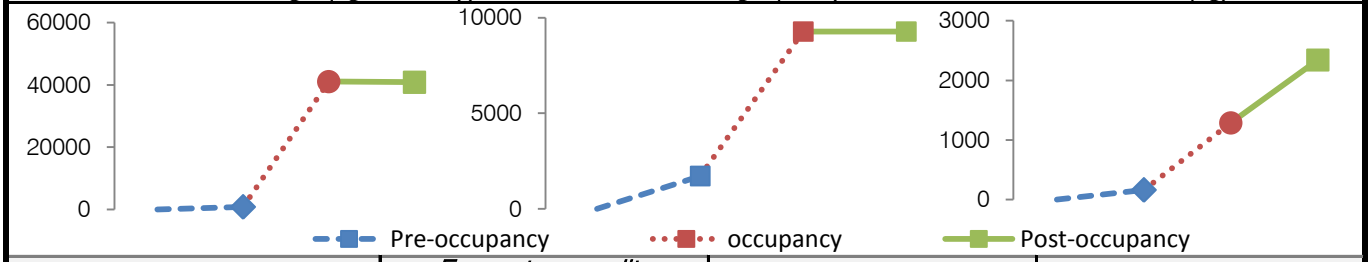


Climate Change Benefits by Category

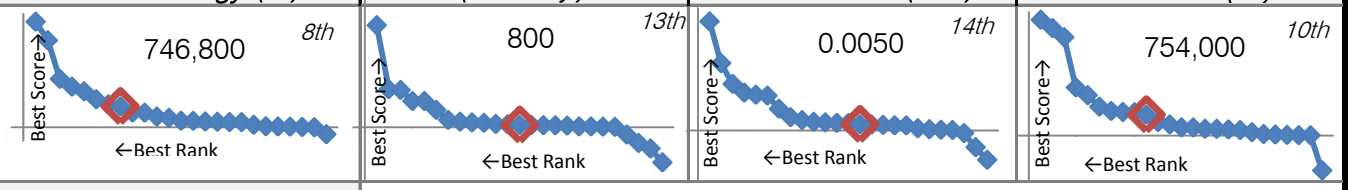


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
746,800 *8th*	800 *13th*	0.0050 *14th*	754,000 *10th*



Comments and uncertainties

Adaptability: Reduced Remodeling *Practice #8*

Description of Waste Prevention Practice

Design for adaptability allows houses to be designed and constructed for both reuse and changes in the occupant's needs. This approach is intended to reduce new materials consumption and waste in construction, renovation, and demolition of buildings. This scenario is intended to represent the potential benefits of reducing remodeling of homes.

Description of Stage I Modeling

The replacement of materials due to homeowner preference has been set to zero. This results in lengthening the lifetime of materials with theh assumption that their replacement will be caused by other factors, such as reaching the end of their service life or being otherwise damaged.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	B	C

Summary of Findings

Reduced consumption of a wide variety of materials results in environmental benefits that place this practice among the middle of the practices that have been evaluated. Its waste prevention score is similar. It is among the best practices in cost savings.

Recommended Actions

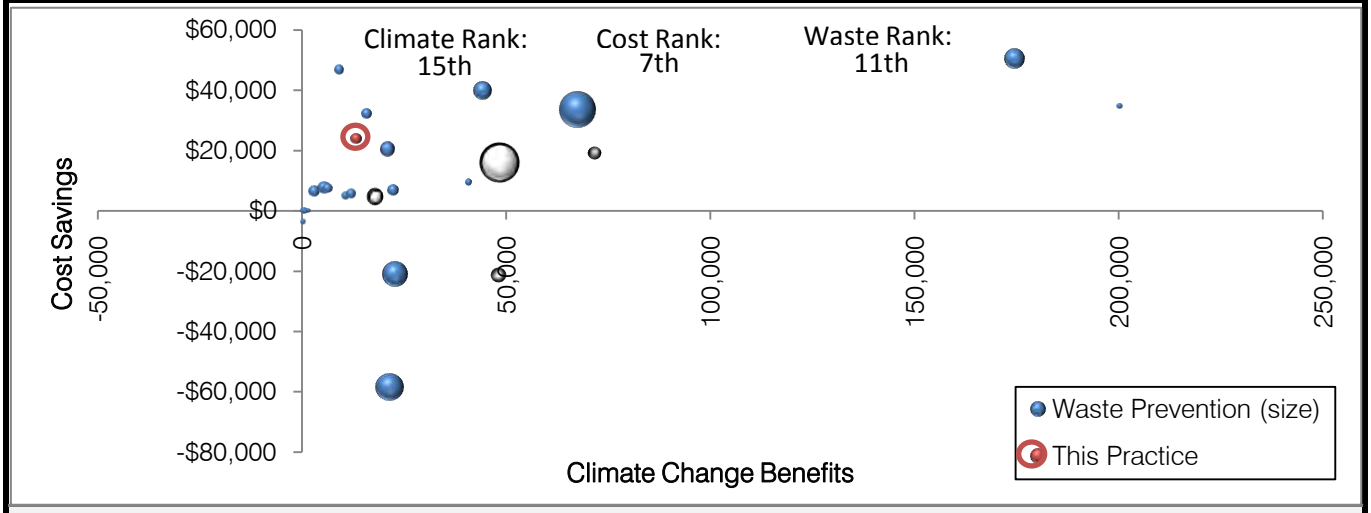
Consider for Phase II as part of an Adaptability scenario

Feasibility

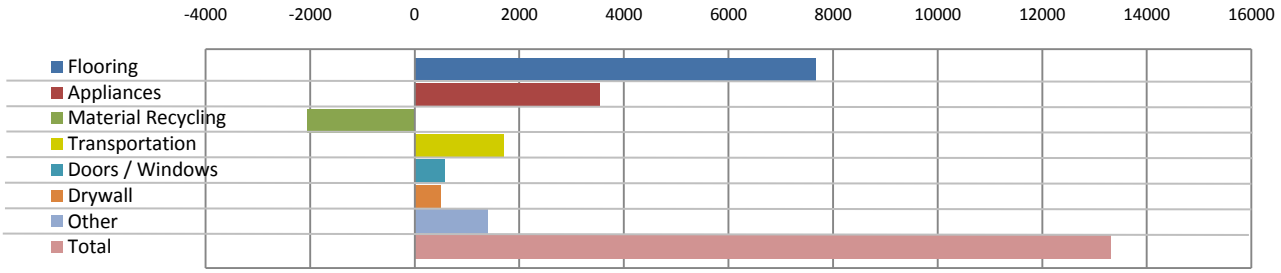
Difficulty to implement	May be difficult in a small number of home designs		
Acceptability to homeowner	Homeowners may prefer to have adaptable home		
Acceptability to builder	Mixed; will require different equipment, techniques, more time.		
Potential market penetration	Complete penetration possible		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Very limited applicability
Other comments	Remodeling may cause improvements in energy efficiency. A difference in energy efficiency caused by lesser remodels has not been considered here.		

Adaptability: Reduced Remodeling *Practice #8*

Environmental Impacts, Costs and Waste Prevention

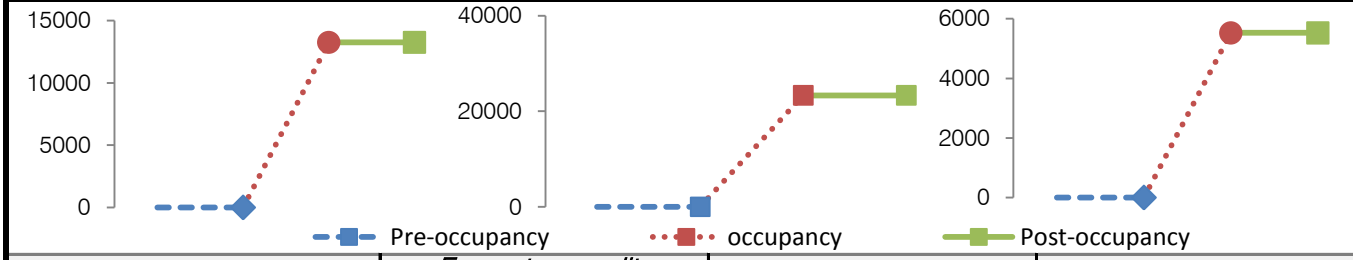


Climate Change Benefits by Category

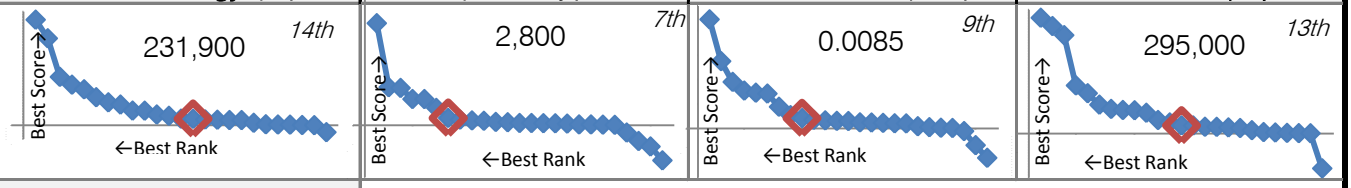


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
231,900 *14th*	2,800 *7th*	0.0085 *9th*	295,000 *13th*



Comments and uncertainties

Flashing and Rainscreening *Practice #9*

Description of Waste Prevention Practice

The proper use and installation of flashing is critical to prevent water penetration into the building. Rain screen methods create a layer of air between the external siding and the waterproof barrier (Tyvek or other house wrap). The lack of flashing or improperly installed flashing can lead to significant mold and rot problems in the Pacific Northwest climate. Rain screening allows ventilation of air to ensure adequate drying when moisture does penetrate. If mold or rot problems persist, repairing the problem and removing the damaged materials can generate a significant amount of waste that could have been prevented with the proper installation of flashing.

Description of Stage I Modeling

Additional flashing is installed on windows, doors, and roof. A 3/4 inch spacing is provided under the cladding to allow airflow and drying within the wall cavities. The replacement rates are adjusted for many components to reflect reduced damage from water infiltration.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	C	B

Summary of Findings

Decreased damage causes less replacement of most interior parts of the home. Reduced environmental impacts provide a moderate benefit relative to other practices. Waste prevention and cost savings are also in a moderate range.

Recommended Actions

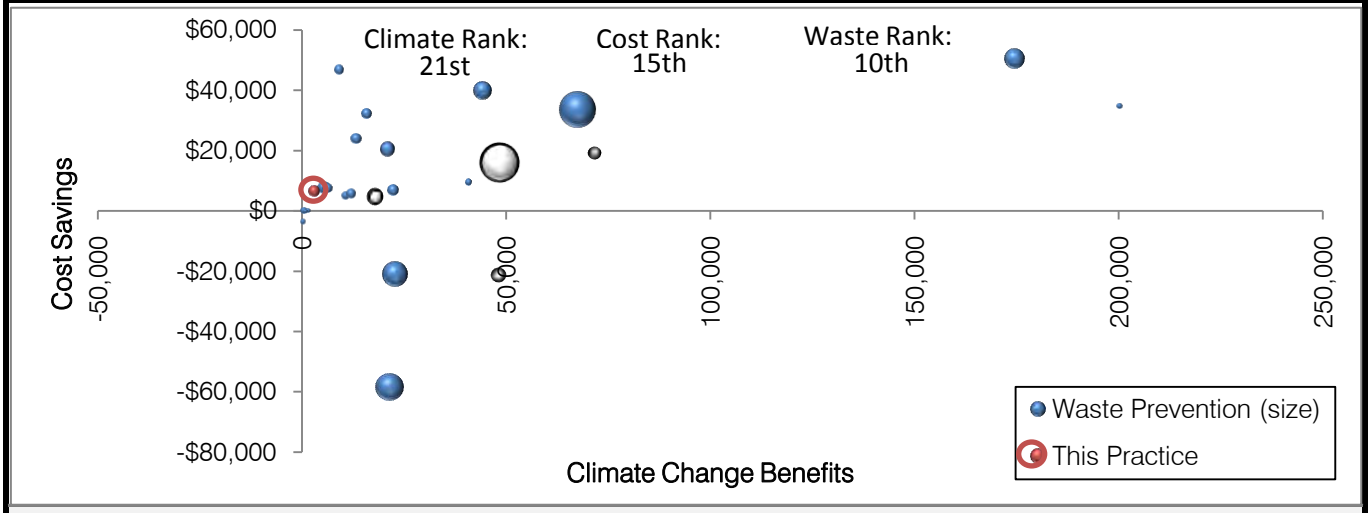
Consider for Phase II

Feasibility

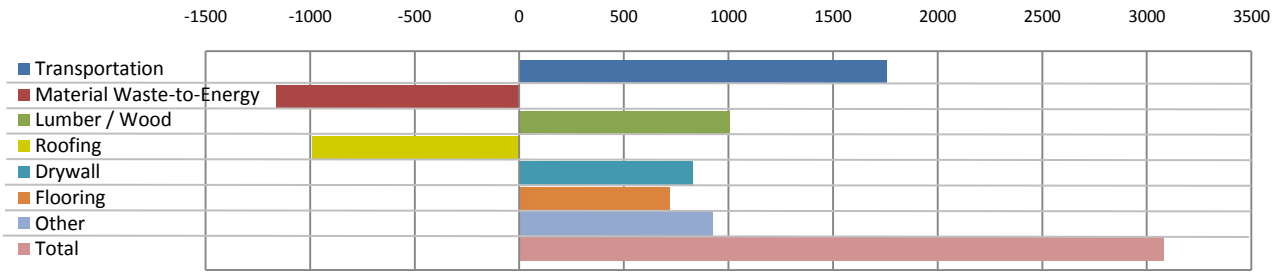
Difficulty to implement	Requires education and training, possible cost concerns		
Acceptability to homeowner	Homeowner may value		
Acceptability to builder	Acceptable, provided flexibility		
Potential market penetration	Degree of implementation may vary by climate		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Limited to full re-siding
Other comments	0		

Flashing and Rainscreening *Practice #9*

Environmental Impacts, Costs and Waste Prevention

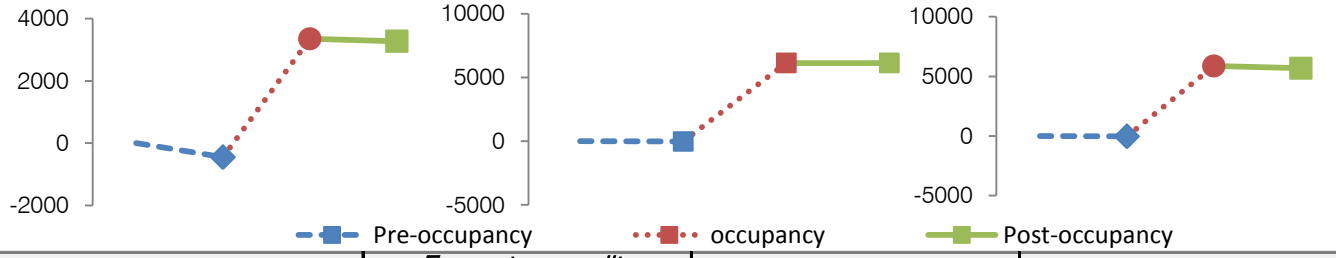


Climate Change Benefits by Category

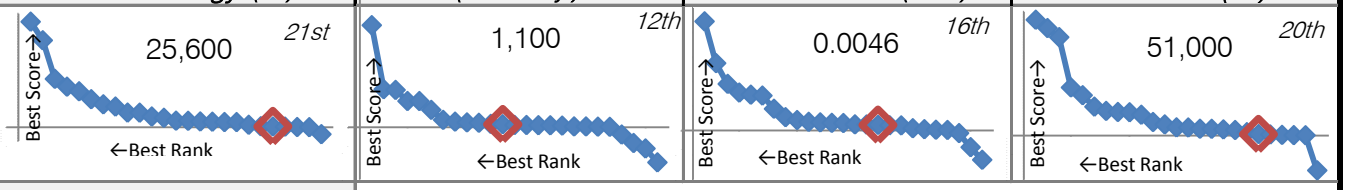


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
25,600 *21st*	1,100 *12th*	0.0046 *16th*	51,000 *20th*



Comments and uncertainties

Deconstruction *Practice #10*

Description of Waste Prevention Practice

Deconstruction is the process of hand or mechanical dismantling a structure in the opposite order it was originally constructed. The purpose is to salvage building materials for re-use. Other advantages include creating more jobs than a typical demolition would, salvaging historic and rare materials, and in some cases, preserving the history of the building contents and personal possessions. The act of deconstructing a home is likely to take less energy than mechanized demolition. Salvaging the building materials reduces waste and conserves a significant amount of upstream costs associated with the extraction, production, and transportation of materials.

Description of Stage I Modeling

Materials are represented as in the standard home. At end of life, materials are reused based on estimates of the typical recovery of each material type from Deconstruction. Those materials are assumed to be transported a given distance and then used in place of virgin materials. For salvaged materials, a credit is given at end-of-life equal to the production of the original materials.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	A	C

Summary of Findings

Reuse of materials at end-of-life provides environmental benefits that are significantly higher than the other waste management options. The resulting climate change benefits place this practice above average, with even better scores in other environmental categories. This practice scores very well in waste prevention, but poorly in cost savings.

Recommended Actions

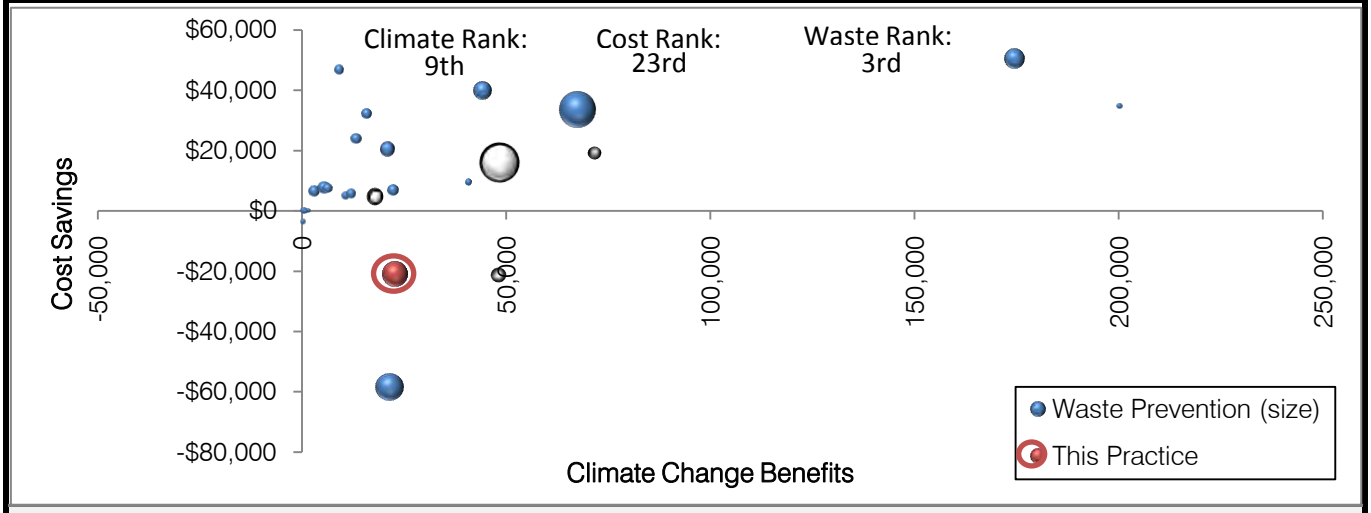
Advance to Phase II, perhaps linked with use of salvaged materials

Feasibility

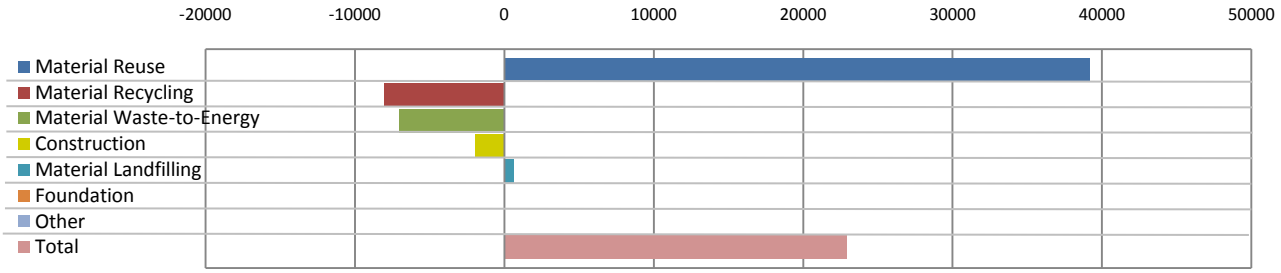
Difficulty to implement	Requires added time and possibly cost; must have market for materials		
Acceptability to homeowner	There can be added costs and time involvement. There may also be tax incentives.		
Acceptability to builder	Acceptable, pending cost differences		
Potential market penetration	May require market development; some homes may have limited recoverability; hazardous materials; some materials are dated; may have cost barrier		
Applicable to multi-family	Equally		
Applicable to new construction	Not for many years	*Applicable to existing homes*	Equally
Other comments	Benefits will depend on whether there is a demand to use the material		

Deconstruction *Practice #10*

Environmental Impacts, Costs and Waste Prevention

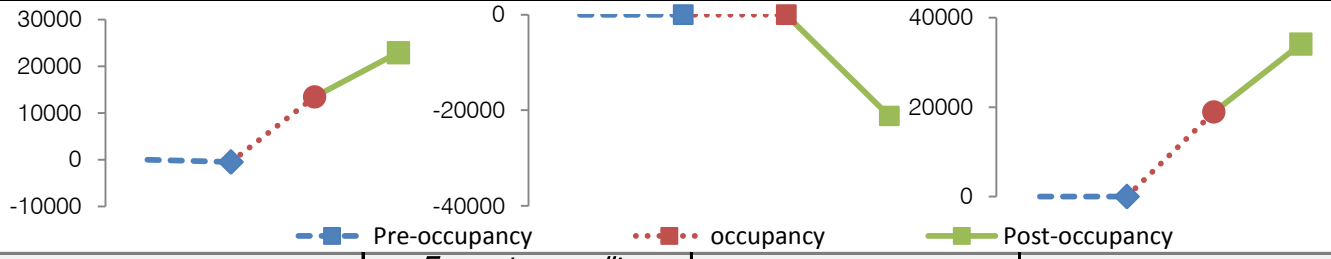


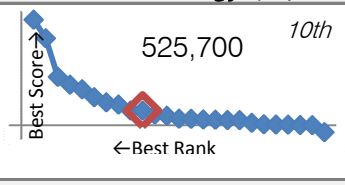
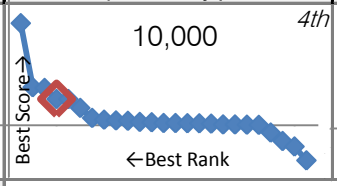
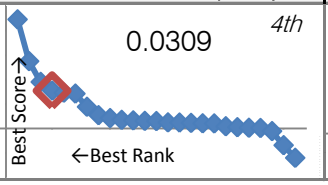
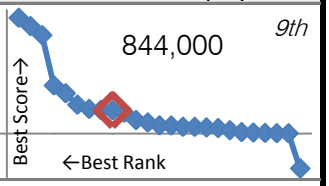
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			
525,700 *10th*	10,000 *4th*	0.0309 *4th*	844,000 *9th*
Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank

Comments and uncertainties	Applying an allocation factor of 50% to the credit given at end-of-life would result in a lesser value. This should therefore be seen as an upper bound

Durable Roofing, Flooring and Siding *Practice #11*

Description of Waste Prevention Practice

The durability of building materials has a direct effect on how often a homeowner will have to replace that material and how much waste is generated by that replacement. More durable products last longer and have the potential to prevent waste that would have otherwise been generated by a less durable material. More durable materials also may have greater upstream impacts. For example, a metal roof may have more upstream impacts associated with mining metals, manufacturing the roof, and transporting it than an asphalt shingle roof may have. However, a metal roof is likely to last much longer than an asphalt shingle roof. Materials to be considered in this evaluation could include flooring choices (hardwood in place of carpeting and ceraminc tile in place of linoleum), (metal roof, asphalt shingles, green roof). One additional consideration of product durability is that often times, materials (like flooring, countertops) are replaced well before their useful life is over due to homeowner design and remodeling choices.

Description of Stage I Modeling

Asphalt roof is replaced with either seamed steel roofing or long-life (40 year) asphalt roofing, linoleum and carpeting are replaced by hardwood and ceramic tile flooring, wood cladding is replaced by cement fiber cladding.

Environment Grade	Waste Prevention Grade	Feasibility Grade
B	B	C

Summary of Findings

Benefits from switching materials show a large benefit, especially in the case of flooring, where hardwood is shown to greatly outperform carpet. The combination of benefits place this among the best performing practices. An increase Cost and waste savings are similarly high. in Ecosystem Quality impact is seen, caused by the steel roof.

Recommended Actions

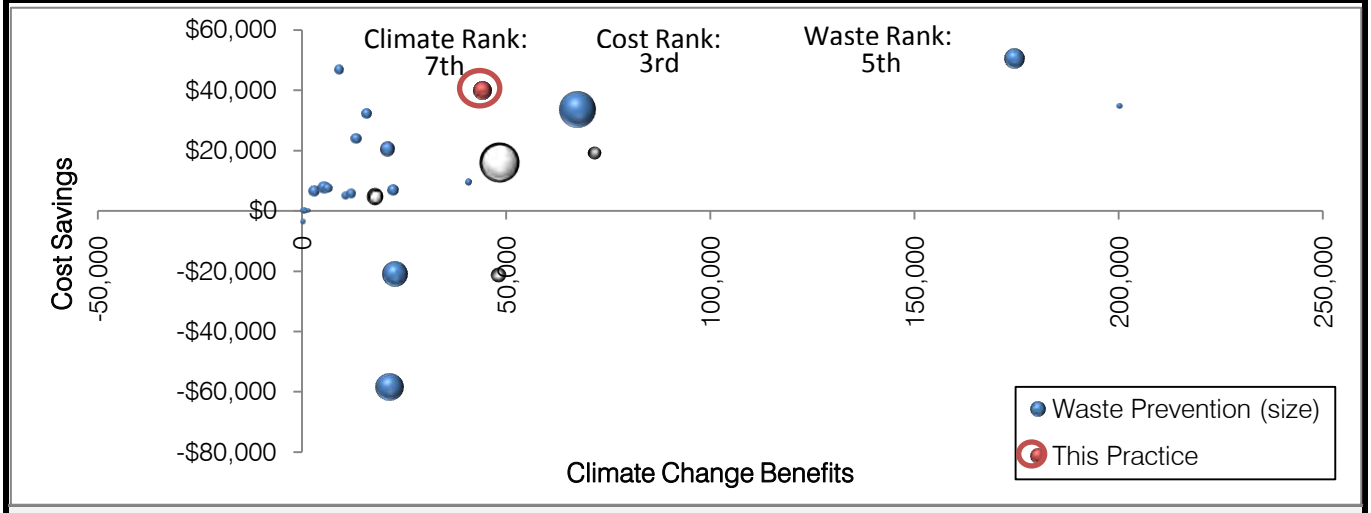
Advance to Phase II

Feasibility

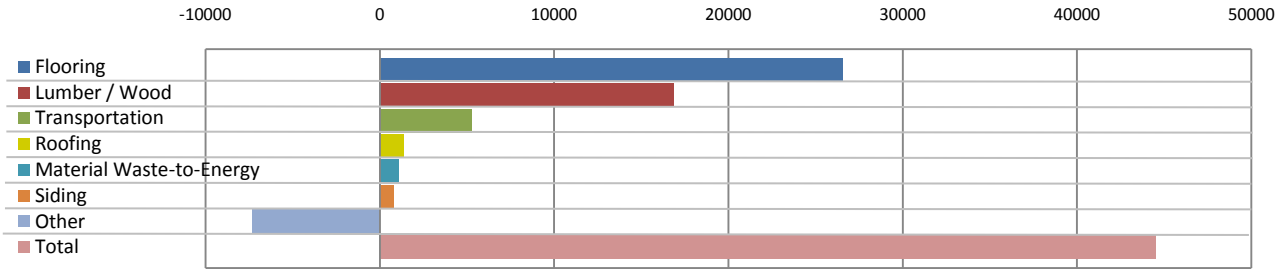
Difficulty to implement	Identifying "durable materials", identifying other considerations		
Acceptability to homeowner	Homeowners will prefer at neutral cost, may not be willing to pay additional cost.		
Acceptability to builder	Availability of materials, concerns over homeowner willingness to pay		
Potential market penetration	Full		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	***Applicable to existing homes***	Equally
Other comments	Durability will depend on installation, maintenance. In most cases, an evaluation will need to be done on each material type to identify those with environmental benefits. "Durability" may not be the key; perhaps a practice of LCA-based screening is a better option.		

Durable Roofing, Flooring and Siding *Practice #11*

Environmental Impacts, Costs and Waste Prevention

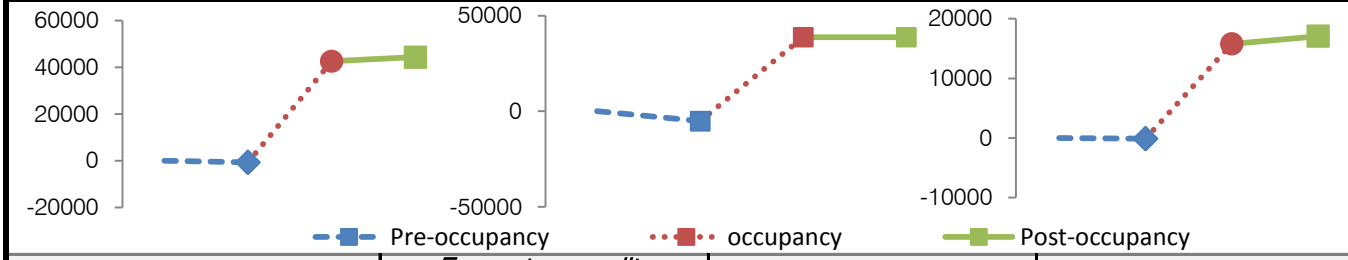


Climate Change Benefits by Category

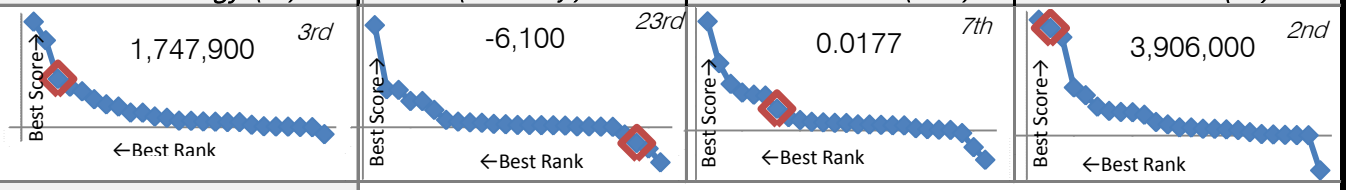


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
1,747,900 *3rd*	-6,100 *23rd*	0.0177 *7th*	3,906,000 *2nd*



Comments and uncertainties

Design Using Salvaged Materials *Practice #12*

Description of Waste Prevention Practice

Designing a house using salvaged materials avoids the upstream environmental costs associated with material extraction, production, and transportation. Design approaches can simply specify a reclaimed wall stud or specify a more creative reuse of multiple materials combined.

Description of Stage I Modeling

Assumes that wherever practicable, components of the home are built and maintained using materials salvaged from another home. Salvaged materials are assigned no impacts to produce. It is assumed that salvaged materials are replaced with salvaged materials throughout the home's life. Construction labor is doubled. No difference is assumed in transportation of materials.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	A	C

Summary of Findings

Ability to use salvaged material results in a substantial environmental advantage, especially from the use of salvaged carpet throughout the home's life. The benefits place this among the best practices in environmental performance. The waste prevention is the best among all practices, while cost ranks high as well.

Recommended Actions

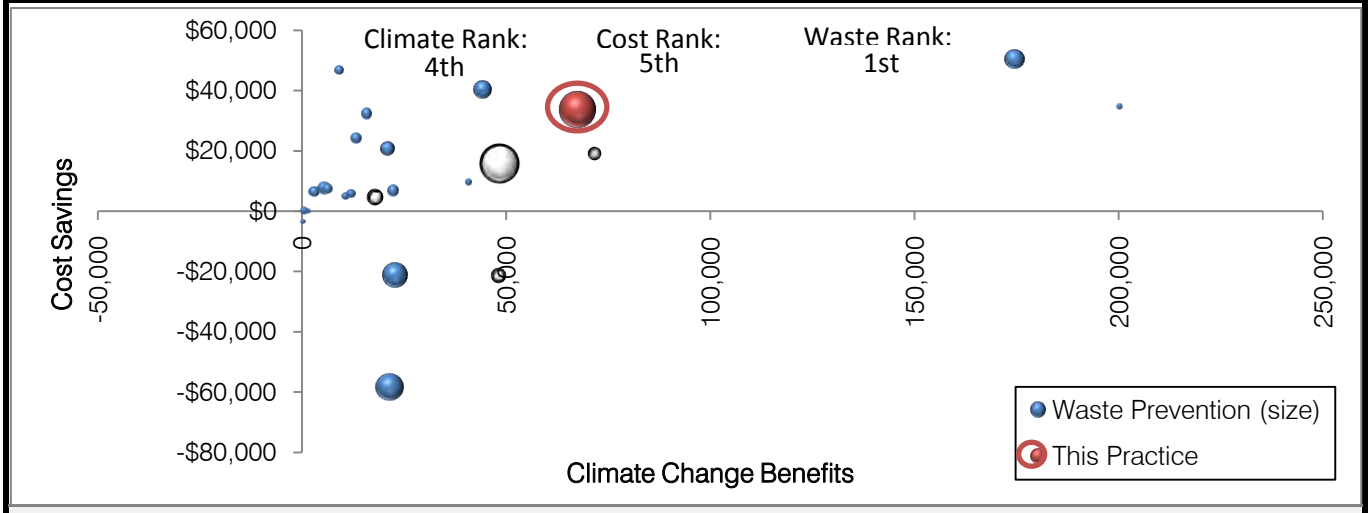
Advance to Phase II, perhaps linked with Deconstruction

Feasibility

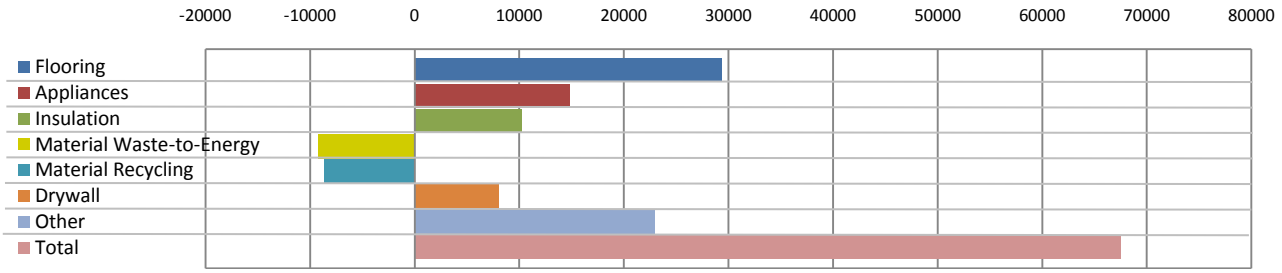
Difficulty to implement	Availability of salvaged materials may be low. Quality of salvaged materials may not be adequate. Extra design or construction work may be needed to accommodate them.		
Acceptability to homeowner	Could vary from higher acceptance to lower, depending on aesthetics and perceived quality. Some materials may have high acceptance and others low acceptance		
Acceptability to builder	Some concerns will exist about material availability, quality and effort		
Potential market penetration	Market penetration will be limited by the ability to source salvaged materials		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Equally
Other comments	This practice is highly linked to Deconstruction for a balance of supply and demand.		

Design Using Salvaged Materials *Practice #12*

Environmental Impacts, Costs and Waste Prevention

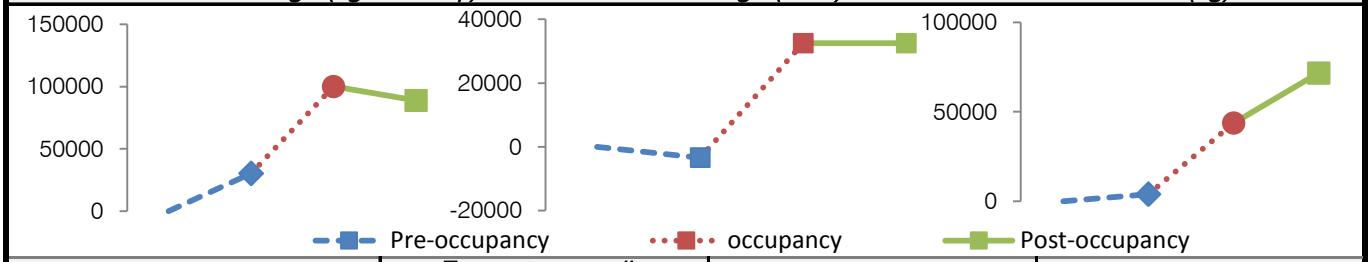


Climate Change Benefits by Category

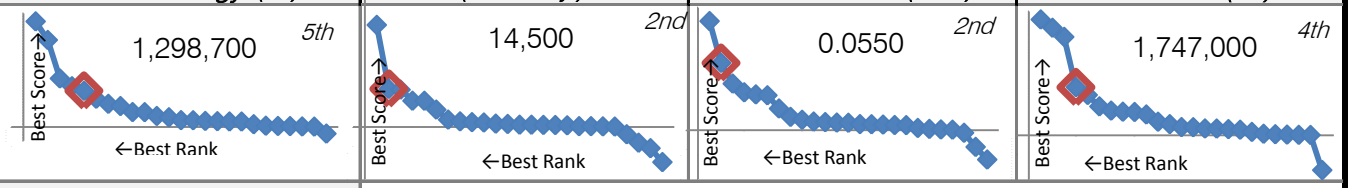


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
1,298,700 *5th*	14,500 *2nd*	0.0550 *2nd*	1,747,000 *4th*



Comments and uncertainties	Assigning half the impacts of production of the salvaged materials would result in a reduction of the benefits by approximately half, but would maintain this practice among the top several practices.

Home-owner Maintenance Training *Practice #13*

Description of Waste Prevention Practice

Many materials that are replaced over the life of a home are influenced by the role of the homeowner in maintaining the home's structure. This may include either work on their own part or hiring of others to maintain each component of the home at an appropriate time. Training homeowners in the proper maintenance tasks, schedules, costs, and more, may encourage better maintenance.

Description of Stage I Modeling

Home components that are susceptible to damage or failure due to poor maintenance are assumed to have an extended service life due training the homeowner on proper maintenance practices and schedules. The revised replacement rates for these materials are listed in the appendix.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	B	C

Summary of Findings

Reduction of replacements due to exterior and interior damage result in the use of less replacement materials, as well as transportation of those materials. The environmental benefit is modest in comparison to other practices, while it scores above average in cost and waste prevention.

Recommended Actions

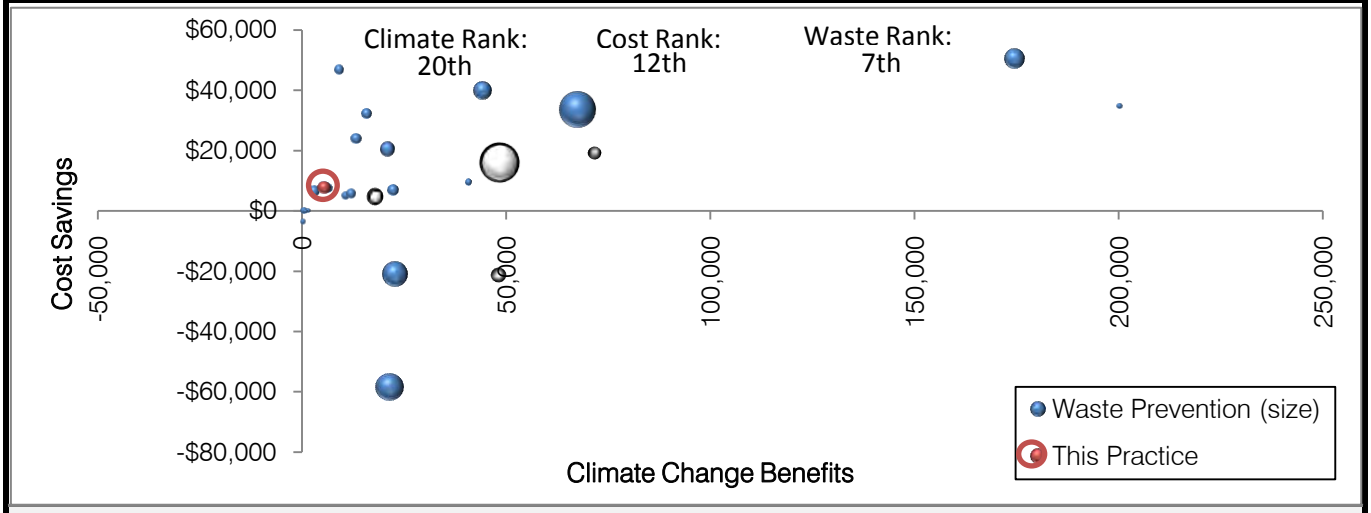
Consider for Phase II

Feasibility

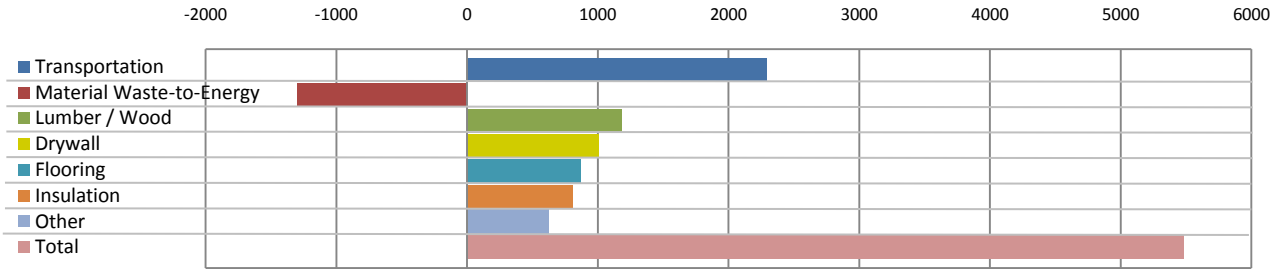
Difficulty to implement	Could require significant resources for a high quality educational program		
Acceptability to homeowner	Likely to be highly accepted; some suggested practices will have higher acceptability than others		
Acceptability to builder	Does not affect builder		
Potential market penetration	No limits in audience for program; the capacity of the program to influence behavior will show a limited penetration, depending on its quality.		
Applicable to multi-family	Equally for owner-occupied. For rented units, a similar program may be needed for property managers		
Applicable to new construction	Equally	*Applicable to existing homes*	Equally
Other comments	0		

Home-owner Maintenance Training *Practice #13*

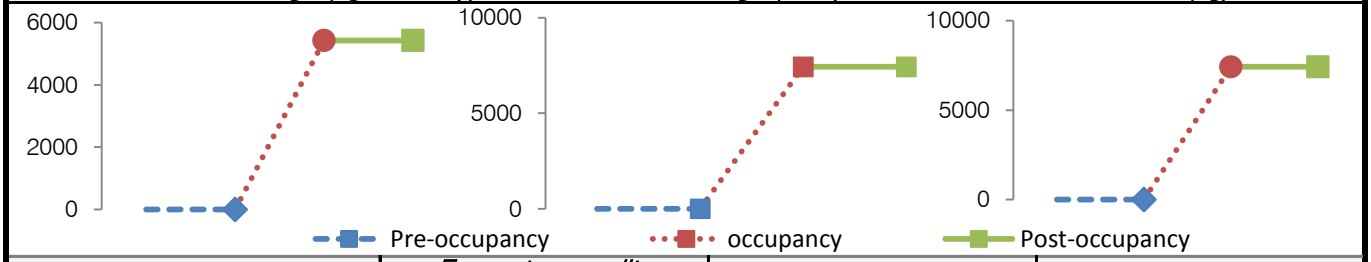
Environmental Impacts, Costs and Waste Prevention



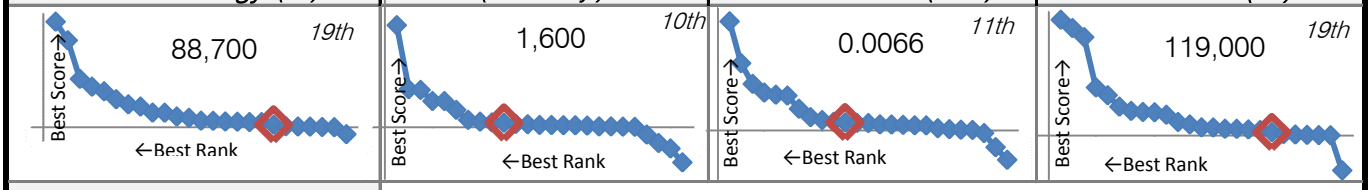
Climate Change Benefits by Category



Time Progression:



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
88,700 *19th*	1,600 *10th*	0.0066 *11th*	119,000 *19th*



Comments and uncertainties	Any increased impacts from maintenance, such as the application of surface treatments, etc., is not considered.

Proper Installation *Practice #14*

Description of Waste Prevention Practice

There are many parts to a home that have a predicted lifespan. Sometimes that lifespan is pre-maturely shortened due to improper installation of materials and mechanical systems. Some materials that can be improperly installed that may lead to pre-mature waste generation include flashing, shingles, roofing, siding, and windows. Building materials have a predicted lifespan that can be influenced by improper installation.

Description of Stage I Modeling

Home components that may fail or be damaged due to improper installation of either these components or others are assumed to have a longer service life due to proper installation. The revised replacement rates for these materials are listed in the appendix.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	C	C

Summary of Findings

Reduction of replacements due to improper installation result in the use of less replacement materials, as well as transportation of those materials. The environmental benefit is modest in comparison to other practices, while it scores above average in cost and waste prevention.

Recommended Actions

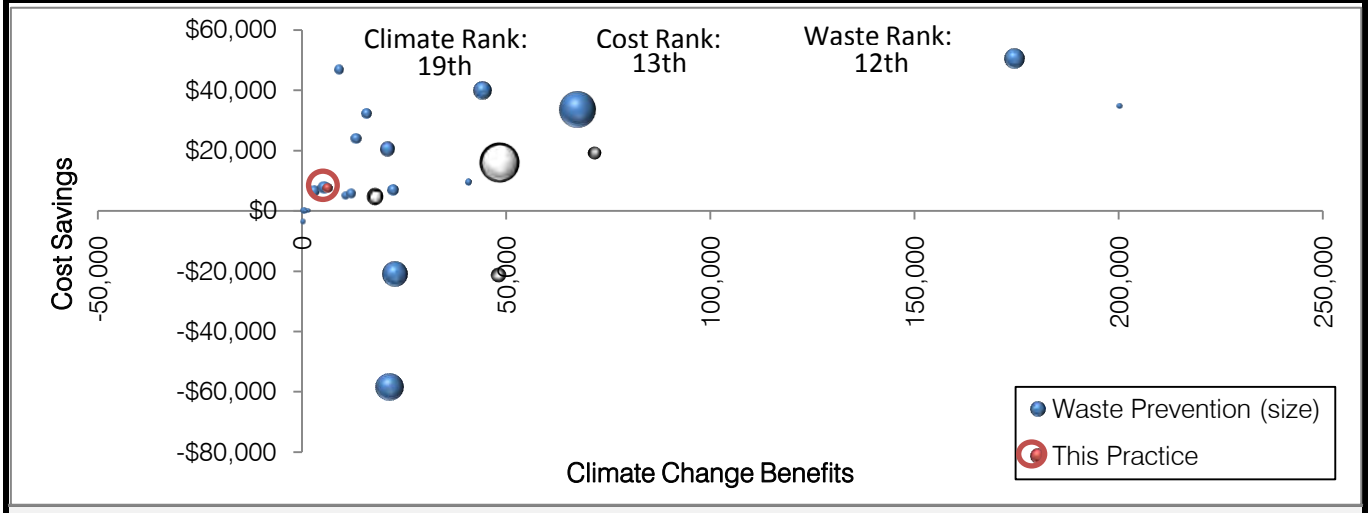
Consider for Phase II

Feasibility

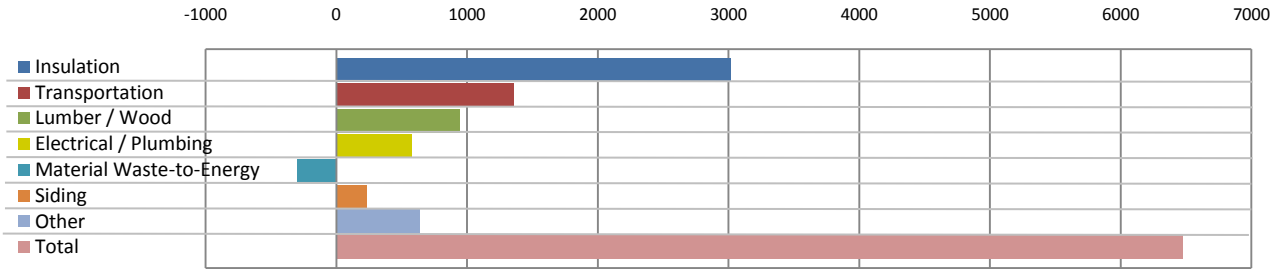
Difficulty to implement	May require additional training, time and/or equipment		
Acceptability to homeowner	Highly acceptable		
Acceptability to builder	Acceptable if the changes to their practice are achievable and at reasonable cost		
Potential market penetration	Absolute perfection is certainly unachievable. It is unclear how far current practice is from what might be achieved with a large emphasis in this area.		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Equally
Other comments	It is not entirely clear how proper installation would be promoted or ensured.		

Proper Installation *Practice #14*

Environmental Impacts, Costs and Waste Prevention

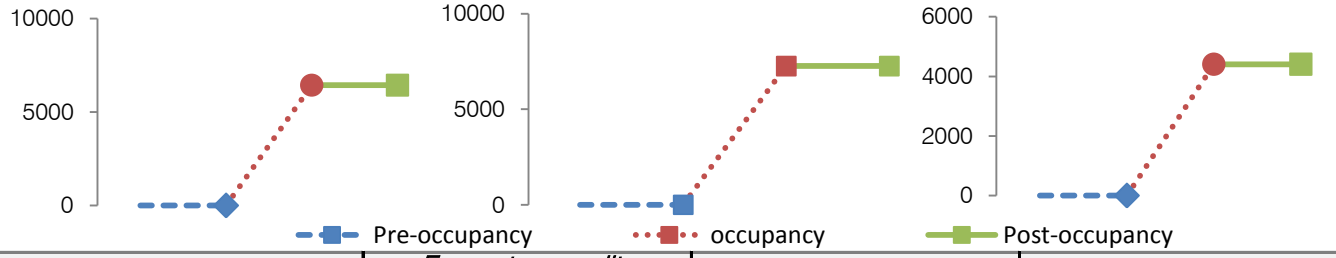


Climate Change Benefits by Category

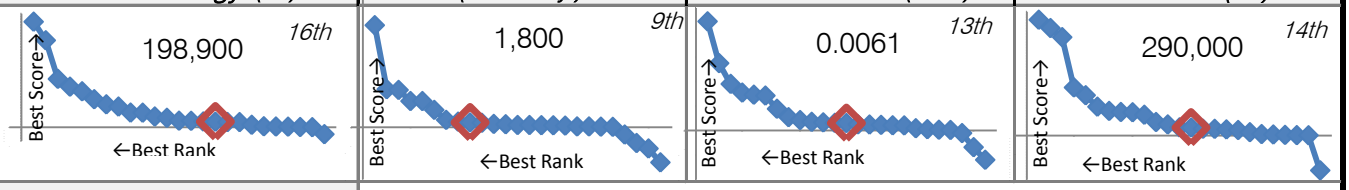


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
198,900 *16th*	1,800 *9th*	0.0061 *13th*	290,000 *14th*



Comments and uncertainties

Restoration *Practice #15*

Description of Waste Prevention Practice

Home restoration allows for the re-use of an existing structure for a significantly extended period of time due to significant repairs, improvements, and modernizations. Rather than the demolition of a home at the end of its life, it allows for an additional life of the home with only a minor fraction of the materials of new home construction.

Description of Stage I Modeling

It is assumed that a pre-existing structure is used for the home. The foundation and structural elements are retained, with 10% replacement of studs and flooring components.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	B	C

Summary of Findings

Reuse of the foundation and studs provides environmental benefit through eliminating the production of these materials and even more benefit by eliminating their transportation. The performance is very good on cost and moderately good on waste prevention.

Recommended Actions

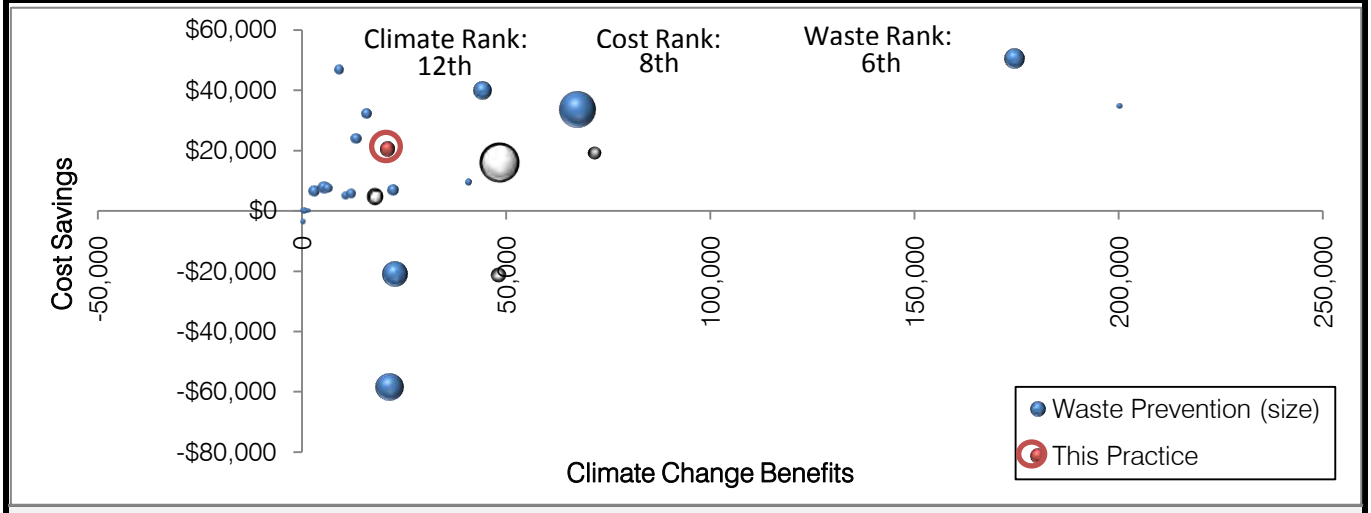
Advance to Phase II, possibly combined with Disassembly and use of salvaged materials

Feasibility

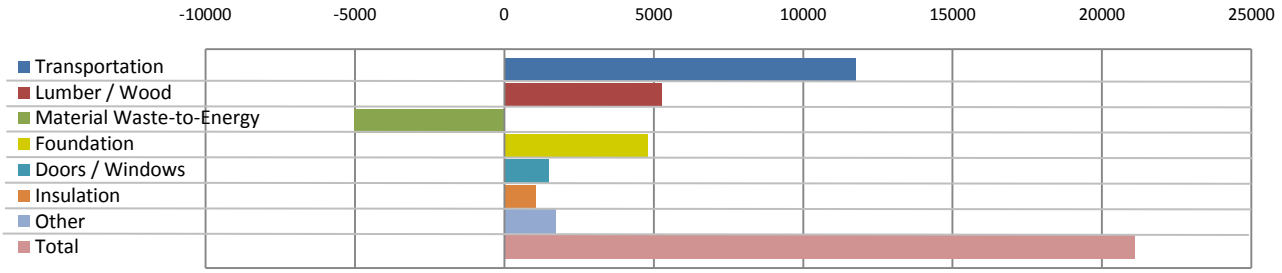
Difficulty to implement	Each site will pose unique challenges, depending on the state and design of the original structure.		
Acceptability to homeowner	Will be highly acceptable to many; others will prefer a newly built structure.		
Acceptability to builder	Highly acceptable		
Potential market penetration	Limited by the availability of existing structures that are in need of restoration and suitable in terms of their structural integrity and the marketability of the finished product in that location.		
Applicable to multi-family	Equally		
Applicable to new construction	Fully applicable (assuming the new structure is considered the equivalent of "new construction")	*Applicable to existing homes*	Not applicable
Other comments	There may be potential for reuse of some materials that are not considered here. This may be part of an integral strategy with Deconstruction and Design Using Salvaged Materials		

Restoration *Practice #15*

Environmental Impacts, Costs and Waste Prevention

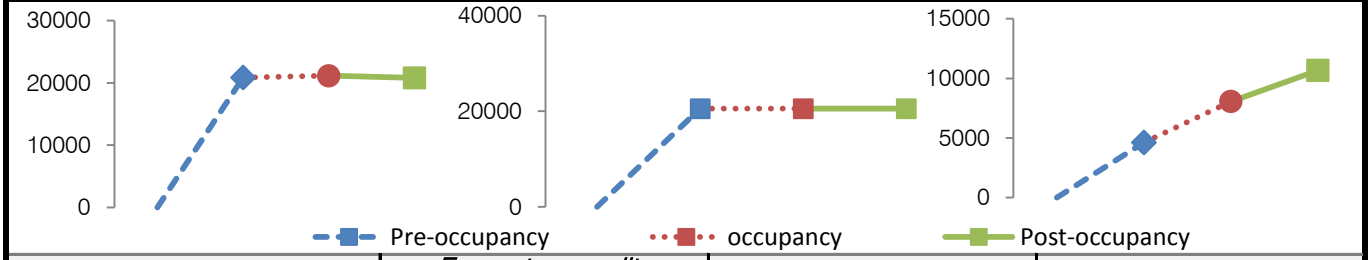


Climate Change Benefits by Category

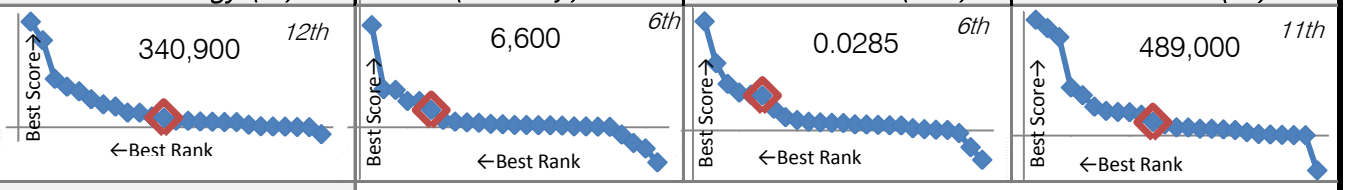


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
340,900 *12th*	6,600 *6th*	0.0285 *6th*	489,000 *11th*



Comments and uncertainties	Assigning half the impacts of production of the salvaged foundation and studs would result in a reduction of the benefits by approximately half, reducing the ranking of this practice further.

Multi-family Housing *Practice #16*

Description of Waste Prevention Practice

Multi-family housing generally allows for sharing of many structural elements among several residences, reducing the material use and waste generation. In addition, shared walls may lead to substantial energy savings for heating and cooling. Multi-family housing can be considered any structure intended to house more than one family, ranging from 2-family units to those housing more than 100. In the present case, it is represented as a set of four units in a row-house similar in structure to the standard home.

Description of Stage I Modeling

The Standard Home is adapted to create a series of four residences within a rowhouse structure. All are kept as similar as is feasible to the Standard Home. The energy modeling is done on the entire structure, dividing by four to give the average energy use of each residence.

Environment Grade	Waste Prevention Grade	Feasibility Grade
A	D	B

Summary of Findings

The savings in energy use are substantial and place this practice among the best performers in climate change benefits. (Check on or explain human health and ecosystem quality). The practice performs moderately well on cost. There is a small net increase in waste generation.

Recommended Actions

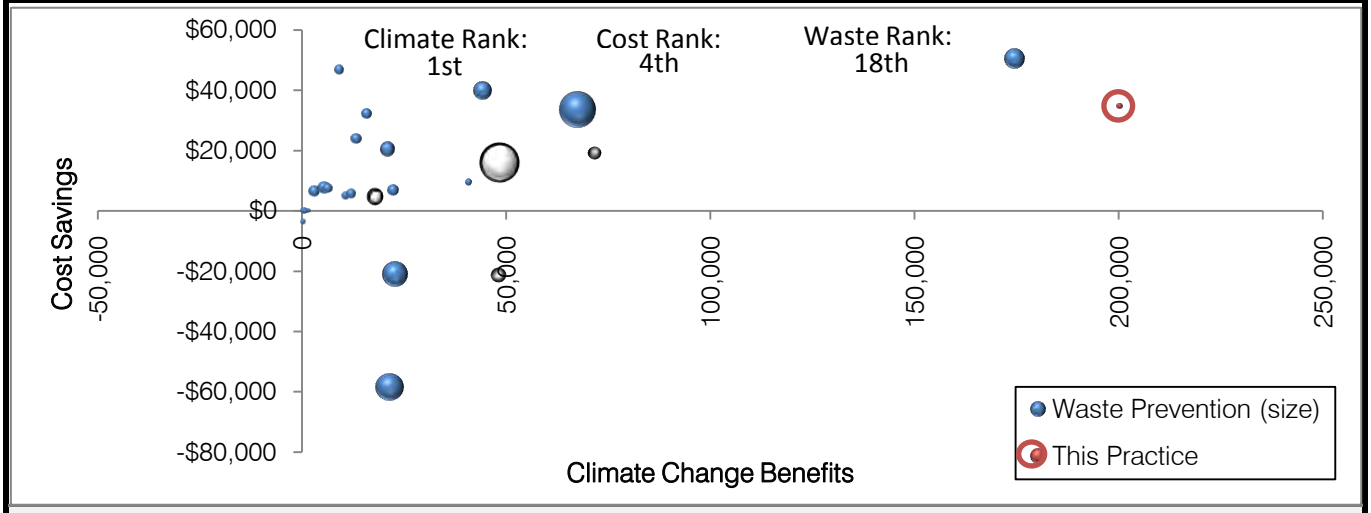
Advance to Phase II

Feasibility

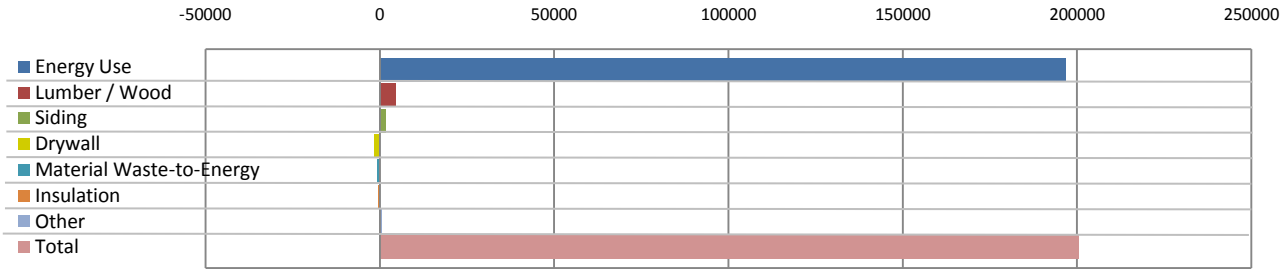
Difficulty to implement	Only limited by acceptability to homeowners		
Acceptability to homeowner	Will be acceptable to some; others will prefer a separate structure.		
Acceptability to builder	Highly acceptable		
Potential market penetration	Limited penetration based on homeowner preferences		
Applicable to multi-family	Fully		
Applicable to new construction	Fully applicable (assuming the new structure is considered the equivalent of "new construction")	*Applicable to existing homes*	Not applicable, with the exception of converting from single to multi-family
Other comments	0		

Multi-family Housing *Practice #16*

Environmental Impacts, Costs and Waste Prevention

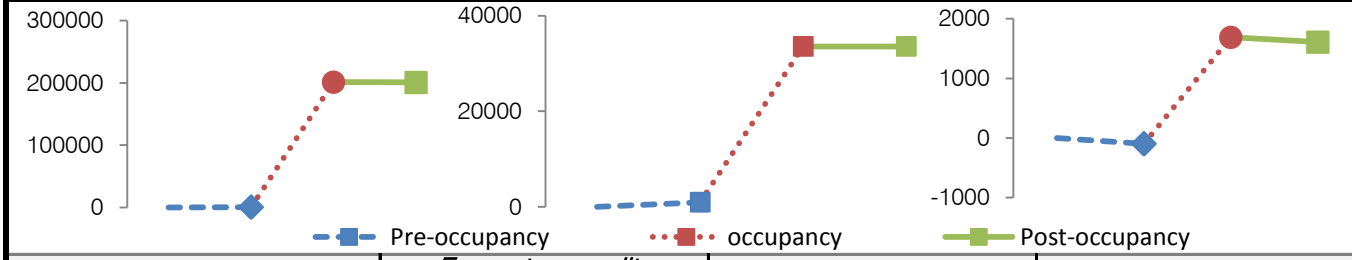


Climate Change Benefits by Category

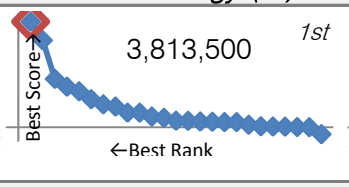


Time Progression:

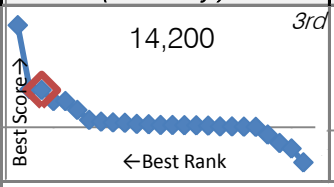
Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



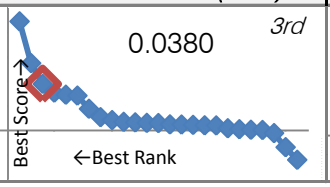
Non-Ren. Energy (MJ)



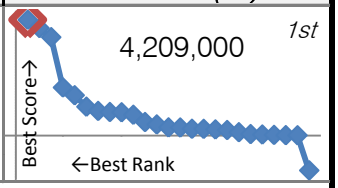
*Ecosystem quality (PDF*m2*yr)*



Human health (DALY)



Resources (MJ)



Comments and uncertainties

Smaller Space Efficient Homes *Practice #17*

Description of Waste Prevention Practice

Changing house size may yield relatively significant environmental impacts through reduction in the required materials to build and maintain the home and through reduced energy use (per housing unit) than larger homes. In addition, smaller homes may also present waste generated by consumer durables (such as furniture and clothing) that fill the house (although these have not been represented in this Phase 1 analysis). In the present assessment, the standard home of 2262 square feet has been redesigned to a size of 1633, with an attempt to retain as much functionality as possible (same number of rooms, etc.)

Description of Stage I Modeling

A smaller house has been modeled by the OHBA to provide a revised materials list. The results were used to conduct energy modeling with REM/RATE.

Environment Grade	Waste Prevention Grade	Feasibility Grade
A	A	B

Summary of Findings

The smaller home has substantially lower energy use, leading to the best overall performance on climate change and the other environmental indicators. Cost savings also rank as the highest, while waste prevention is among the best.

Recommended Actions

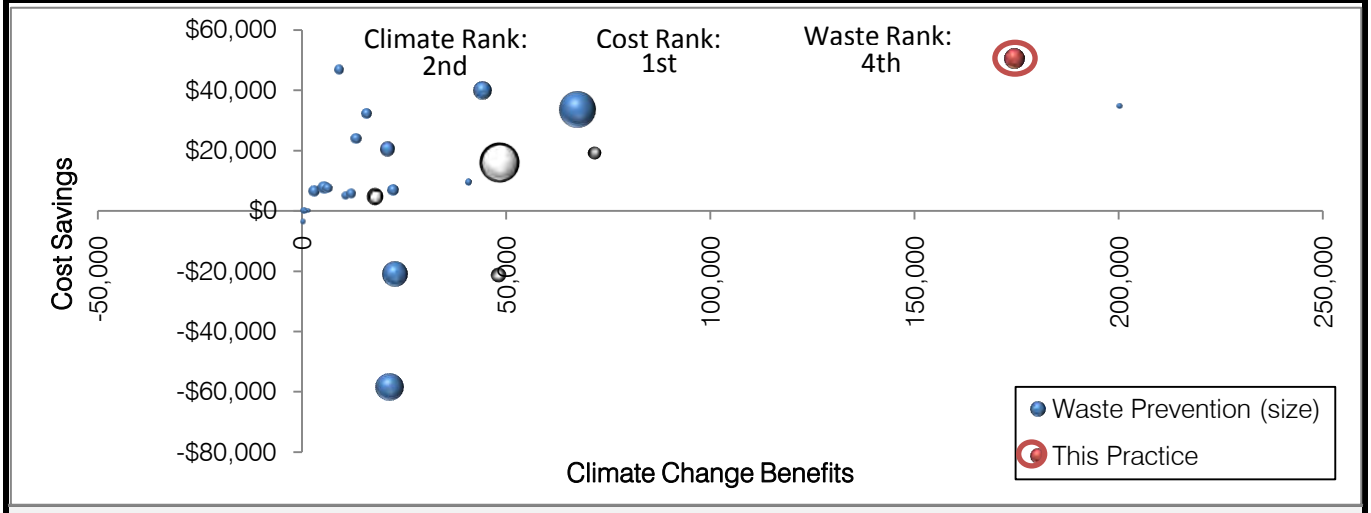
Advance to Phase II

Feasibility

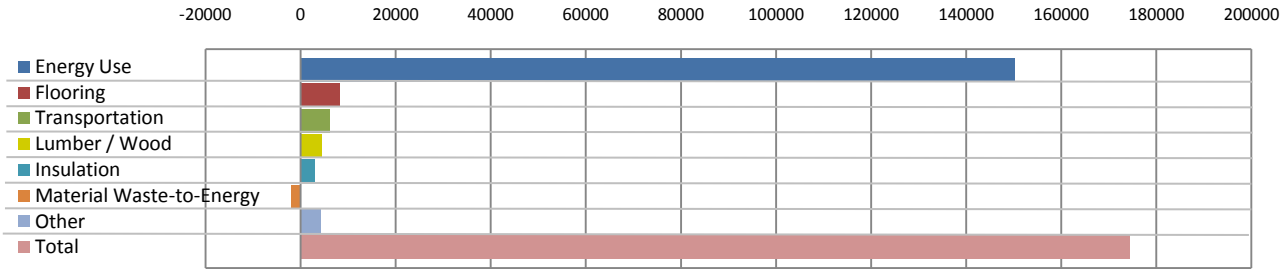
Difficulty to implement	No difficulties		
Acceptability to homeowner	Acceptability will vary; some will be accepting of smaller spaces, some will not.		
Acceptability to builder	Highly acceptable if the market supports it.		
Potential market penetration	Limited by homeowner acceptance/demand.		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Not applicable, with the exception of dividing existing structures into smaller units
Other comments	0		

Smaller Space Efficient Homes *Practice #17*

Environmental Impacts, Costs and Waste Prevention

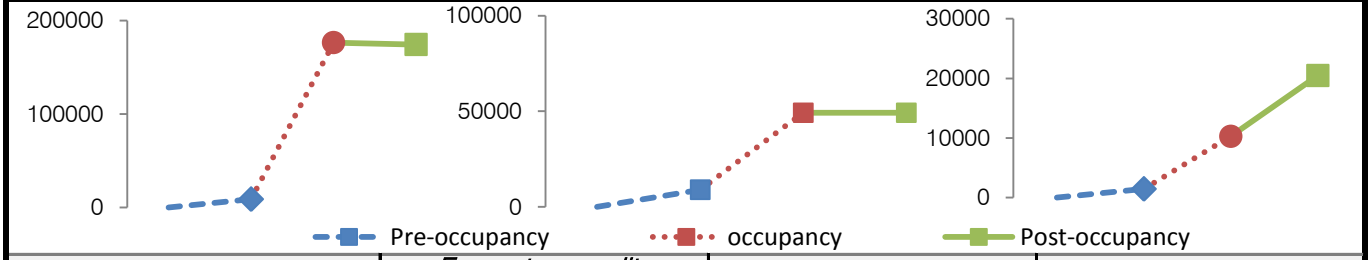


Climate Change Benefits by Category

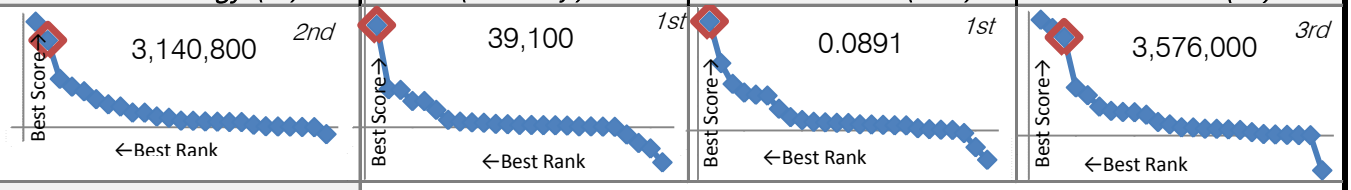


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
3,140,800 *2nd*	39,100 *1st*	0.0891 *1st*	3,576,000 *3rd*



Comments and uncertainties

Insulating Concrete Forms (ICFs) *Practice #18*

Description of Waste Prevention Practice

Insulating concrete forms (ICFs) are reinforced concrete blocks containing and insulating layer. They offer longer durability than standard wood framing, offering the potential for waste savings over the life of a home. In addition, they offer higher energy efficiency. In the present case, all exterior walls have been replaced with ICFs.

Description of Stage I Modeling

ICFs are used for exterior walls. A revised energy use is estimated using REM/RATE.

Environment Grade	Waste Prevention Grade	Feasibility Grade
B	F	B

Summary of Findings

The energy efficiency of the ICFs leads to a very good performance on climate change and the other environmental metrics. Cost savings ranks highly, while waste prevention shows a net negative value.

Recommended Actions

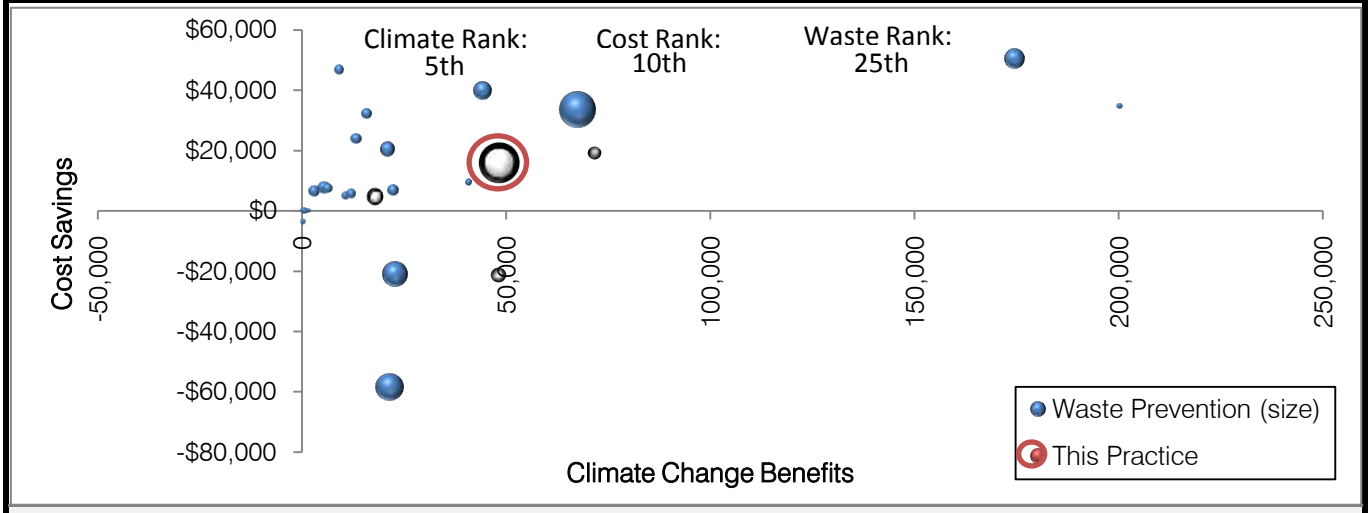
Must clarify whether this is a waste prevention practice. If so, it could be advanced to Phase II

Feasibility

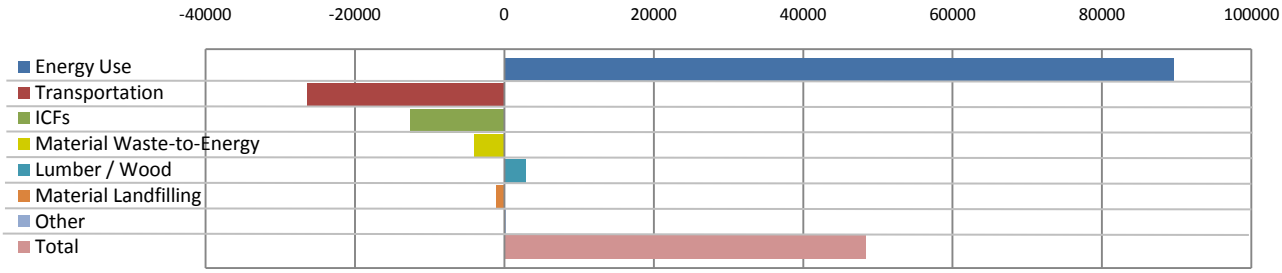
Difficulty to implement	Some additional training required		
Acceptability to homeowner	Highly acceptable, possible aesthetic concerns, depending on design		
Acceptability to builder	Highly acceptable if the market supports it		
Potential market penetration	Nearly full penetration possible		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Limited to significant renovations / additions
Other comments	0		

Insulating Concrete Forms (ICFs) *Practice #18*

Environmental Impacts, Costs and Waste Prevention

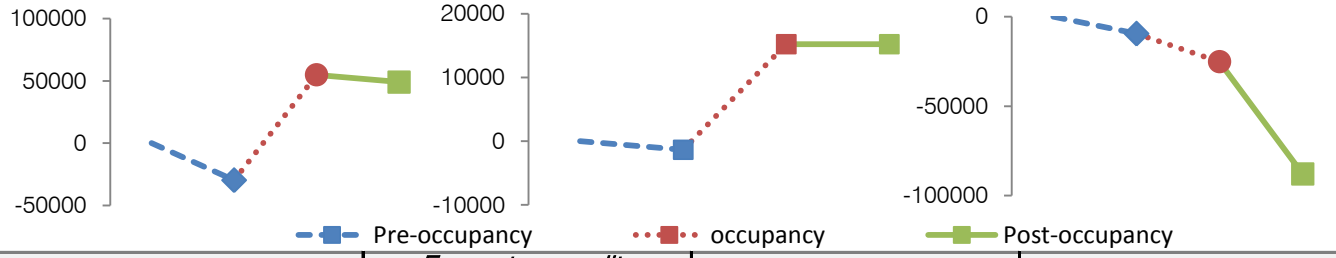


Climate Change Benefits by Category

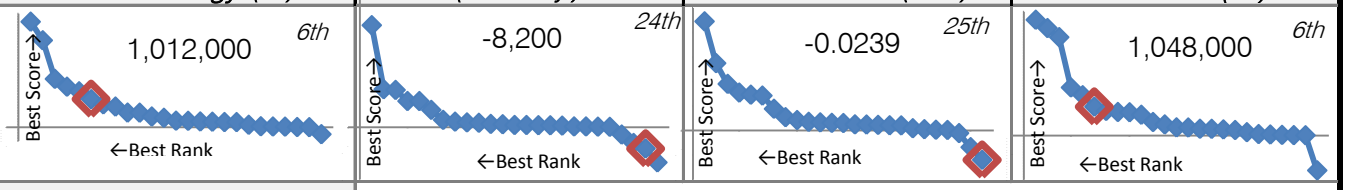


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
1,012,000 *6th*	-8,200 *24th*	-0.0239 *25th*	1,048,000 *6th*



Comments and uncertainties

Structural Insulated Panels (SIPs) *Practice #19*

Description of Waste Prevention Practice

Structural insulated panels (SIPs) are large, pre-fabricated wall panels containing insulation sandwiched between oriented strand board. These panels may reduce on-site construction waste, while leading to greater energy efficiency. The thicknesses of plywood and insulation varies, leading to a range of options that may balance material savings and energy savings. In the present case, all exterior walls and ceiling have been replaced by SIPs. Although this allows for additional insulated attic space that might be used for ducting or other purposes, no changes in ducting were made in this scenario.

Description of Stage I Modeling

SIPs are used for exterior walls. A revised energy use is estimated using REM/RATE.

Environment Grade	Waste Prevention Grade	Feasibility Grade
B	F	B

Summary of Findings

The energy efficiency of the SIPs leads to a very good performance on climate change and the other environmental metrics. Cost savings ranks poorly, while waste prevention shows a net negative value.

Recommended Actions

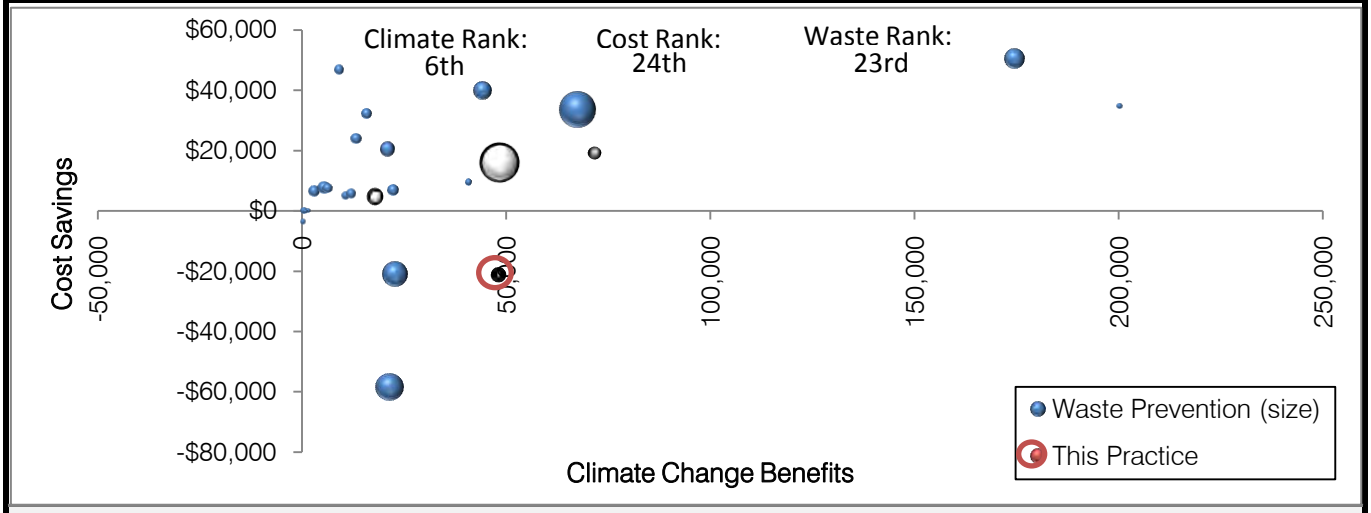
Must clarify whether this is a waste prevention practice. If so, it could be advanced to Phase II

Feasibility

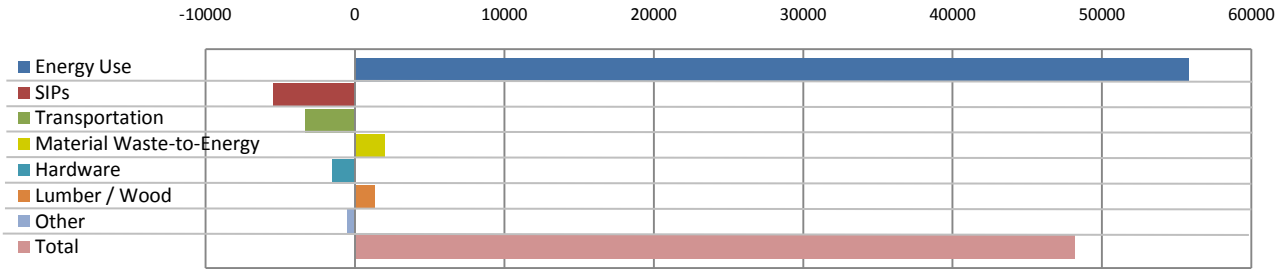
Difficulty to implement	Some additional training required		
Acceptability to homeowner	Highly acceptable		
Acceptability to builder	Highly acceptable if the market supports it		
Potential market penetration	Nearly full penetration possible		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Limited to significant renovations / additions
Other comments	0		

Structural Insulated Panels (SIPs) Practice #19

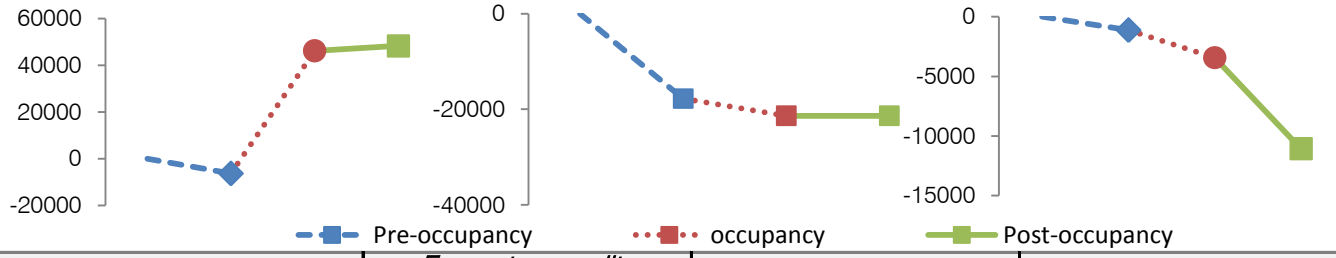
Environmental Impacts, Costs and Waste Prevention



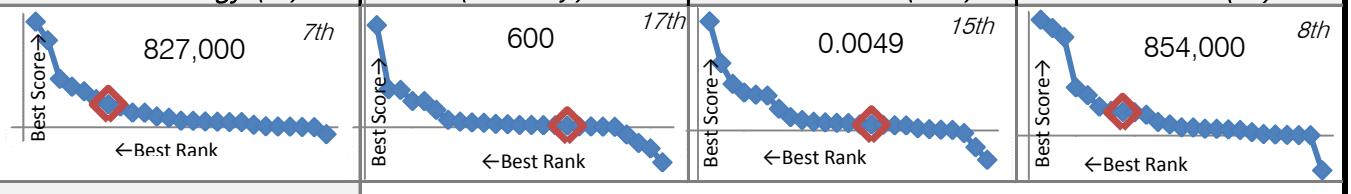
Climate Change Benefits by Category



Time Progression:



Non-Ren. Energy (MJ)	Ecosystem quality (PDF*m2*yr)	Human health (DALY)	Resources (MJ)
827,000	600	0.0049	854,000
7th	17th	15th	8th



Comments and uncertainties

Strawbale *Practice #20*

Description of Waste Prevention Practice

Straw bale construction replaces walls with bales of straw (such as from wheat, oats, etc.), covered by a layer of stucco or plaster.

Description of Stage I Modeling

A revised material list was produced by the OHBA's model, including straw bale for outer walls and a timber-frame structure. Energy use was estimated using REM/RATE.

Environment Grade	Waste Prevention Grade	Feasibility Grade
B	F	B

Summary of Findings

The energy efficiency of the straw bale leads to a very good performance on climate change and the other environmental metrics. Cost savings is in a moderate range, while waste prevention shows a net negative value.

Recommended Actions

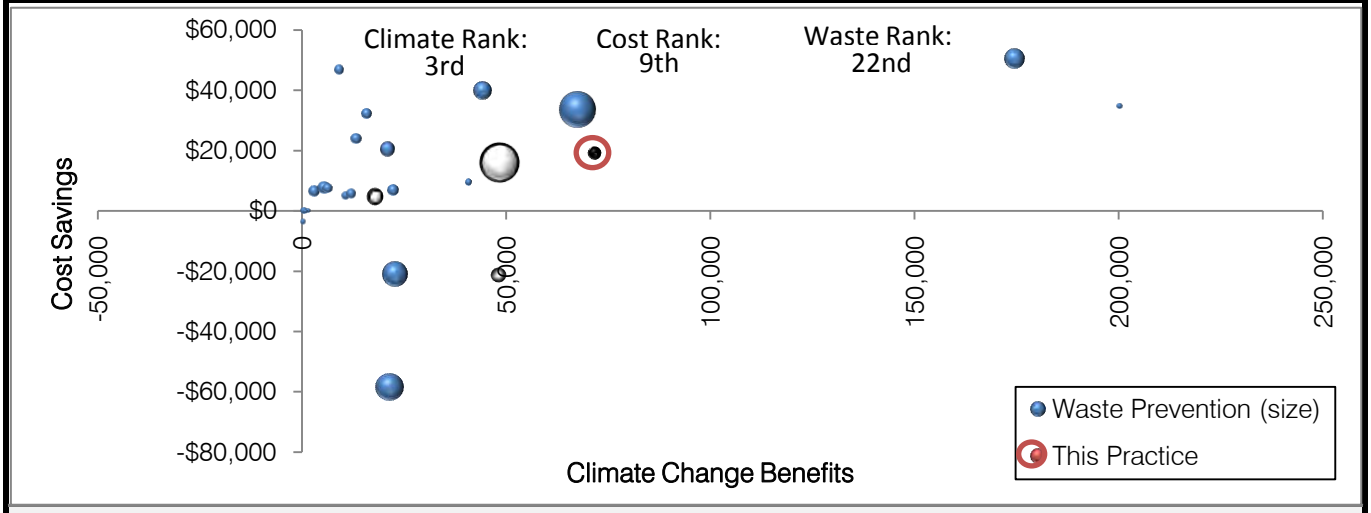
Must clarify whether this is a waste prevention practice. If so, it could be advanced to Phase II

Feasibility

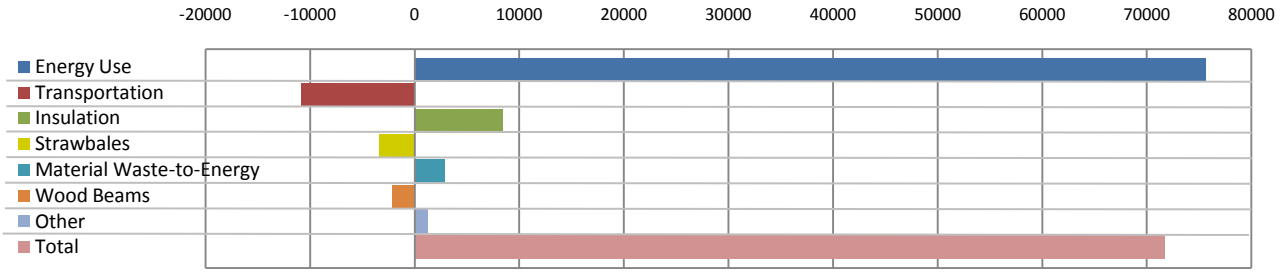
Difficulty to implement	Some additional training required		
Acceptability to homeowner	Varying acceptability, some will favor and other will have aesthetic concerns, depending on design		
Acceptability to builder	Highly acceptable if the market supports it		
Potential market penetration	Market penetration may be limited by material availability; investigation on this topic would be needed.		
Applicable to multi-family	Only applicable on structures up to 2 stories		
Applicable to new construction	Fully applicable	*Applicable to existing homes*	Limited to significant renovations / additions
Other comments	0		

Strawbale *Practice #20*

Environmental Impacts, Costs and Waste Prevention

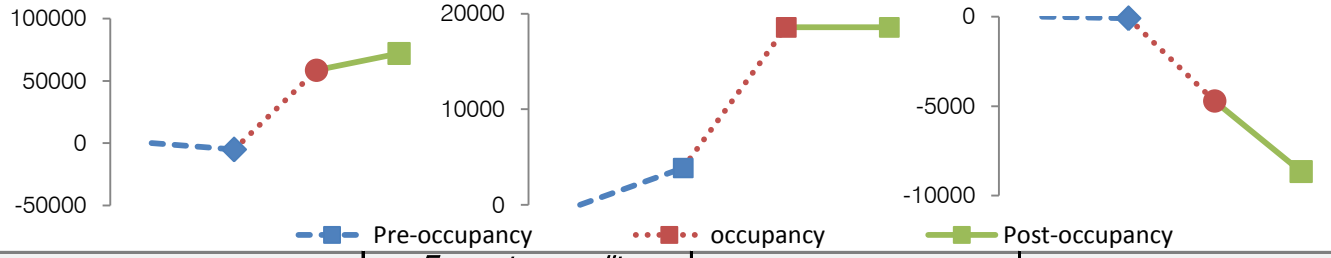


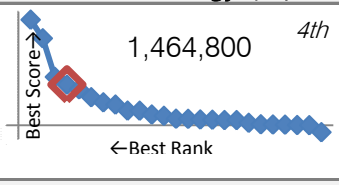
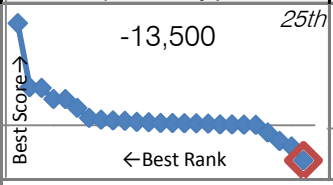
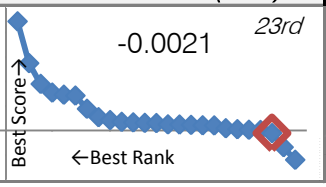
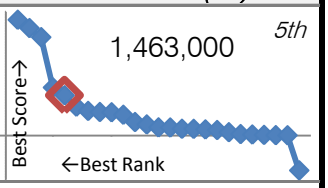
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			
1,464,800 *4th*	-13,500 *25th*	-0.0021 *23rd*	1,463,000 *5th*
Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank

Comments and uncertainties

Thermal Curtains *Practice #21*

Description of Waste Prevention Practice

thermal curtains could be added to existing windows to help insulate from heat loss in winter and block summertime radiation rather than replacing the whole window with a newer more efficient one. It would be assumed that this action is taking place in the middle of the life of a previously built home. The home would therefore have a decreased remaining life compared to new construction and would have a lower energy efficiency. The two options of replacement windows and thermal curtains would be compared over the remaining life of the house.

Description of Stage I Modeling

Curtains are assumed to be added to the home in year 1 and the window replacement for all purposes is set to zero. Curtains are replaced every 20 years. An estimated energy savings of 102 Therms of natural gas per year is assumed.

Environment Grade	Waste Prevention Grade	Feasibility Grade
D	D	A

Summary of Findings

The energy efficiency of the thermal curtains to a very good performance on climate change and the other environmental metrics. Cost savings also ranks highly. Waste prevention is very minimal.

Recommended Actions

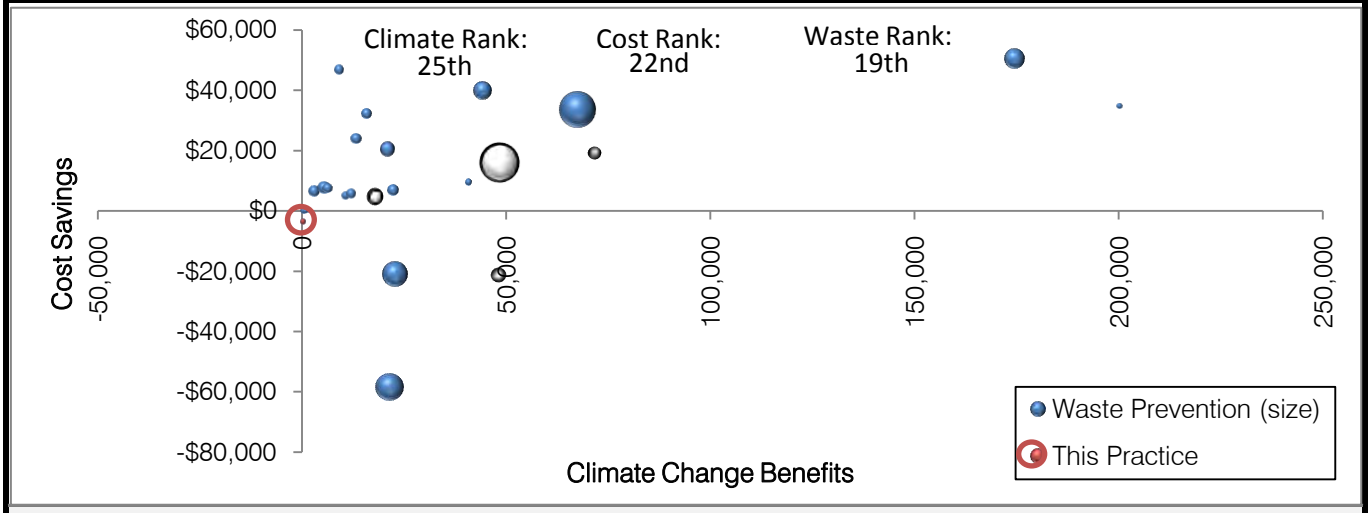
Do not advance to Phase II

Feasibility

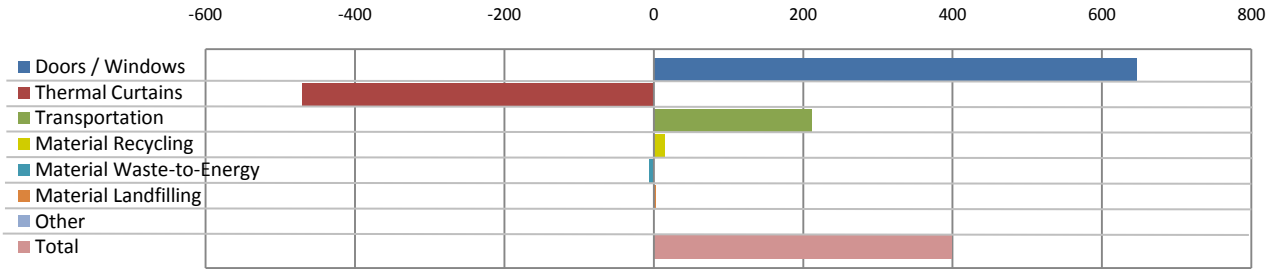
Difficulty to implement	Not difficult		
Acceptability to homeowner	Highly acceptable, especially given cost savings		
Acceptability to builder	Builder not involved		
Potential market penetration	Many windows will require replacement for reasons other than efficiency. Penetration is therefore limited to those windows that are otherwise able to remain in place.		
Applicable to multi-family	Equally		
Applicable to new construction	Equally applicable, but efficiency gains will be lesser on current homes.	*Applicable to existing homes*	Highly applicable
Other comments	0		

Thermal Curtains *Practice #21*

Environmental Impacts, Costs and Waste Prevention

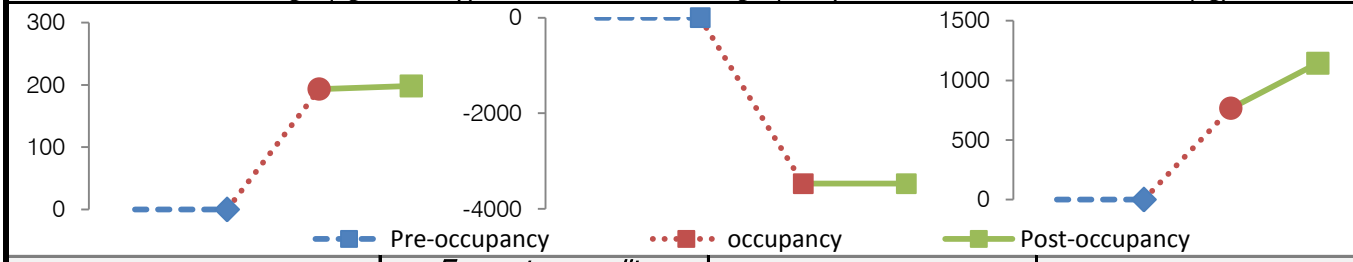


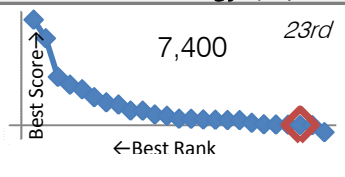
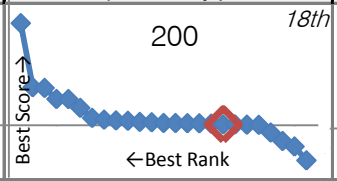
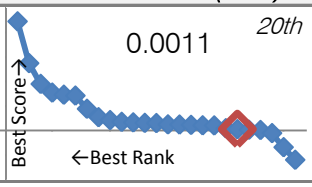
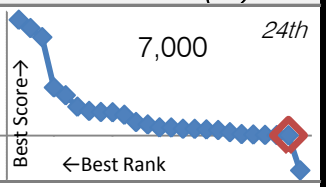
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			
7,400 *23rd*	200 *18th*	0.0011 *20th*	7,000 *24th*
Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank	Best Score→ ←Best Rank

Comments and uncertainties	Some uncertainty regarding relative efficiency of curtains and replacement windows. Curtain efficiency gains will be limited to those hours that curtains are covering windows. The analysis done here is not a complete LCA on these products, which may be warranted if it is desired to

Reusable Packaging *Practice #22*

Description of Waste Prevention Practice

Many building materials, like most products, require a significant amount of packaging. In most cases, this packaging is disposed of in the process of construction. There may be possibilities for reusing packaging, decreasing the total amount of material required to protect and transport the products to the site by spreading the burdens of that material out over many uses. Reusable packaging would likely require other materials and differing (probably greater) weight per amount of material packaged.

Description of Stage I Modeling

Cardboard, low density polyethylene and polystyrene packaging are replaced by polypropylene packaging. The total packaging weight is increased by 50%. An allocation factor of 0.05 is applied to reflect an assumption that packaging is used an average of 20 times. No return distance is assumed for packaging.

Environment Grade	Waste Prevention Grade	Feasibility Grade
D	D	D

Summary of Findings

The benefits of reusable packaging are substantially smaller then the majority of other practices considered. Waste prevention and cost are also low.

Recommended Actions

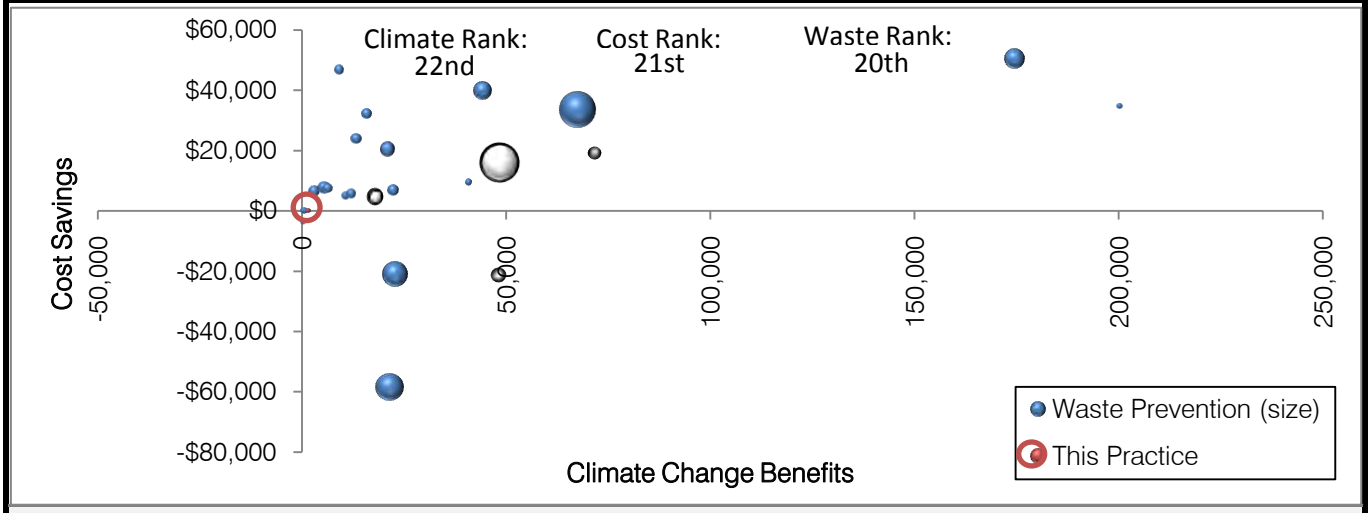
Do not advance to Phase II

Feasibility

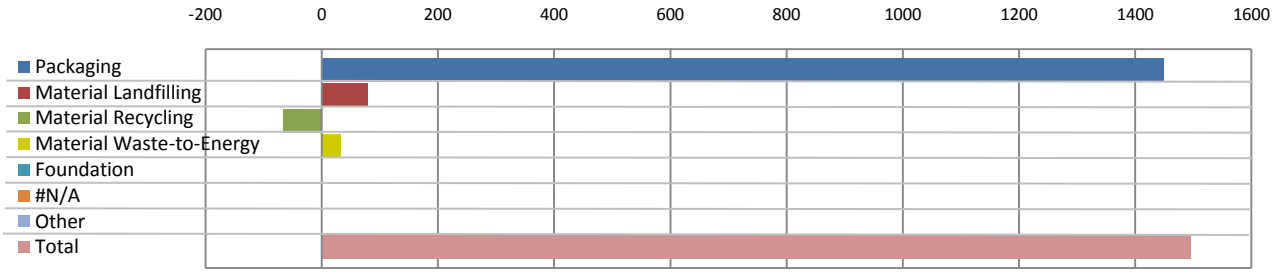
Difficulty to implement	Many difficulties with recovering, separating and transporting packaging for reuse.		
Acceptability to homeowner	No perceived difference		
Acceptability to builder	Acceptability will vary with the temperament of the builder; low acceptability could hurt recovery rates		
Potential market penetration	Potential is high; aggressive approach such as a deposit system may be needed to ensure high rates of recovery.		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Equally
Other comments	0		

Reusable Packaging *Practice #22*

Environmental Impacts, Costs and Waste Prevention

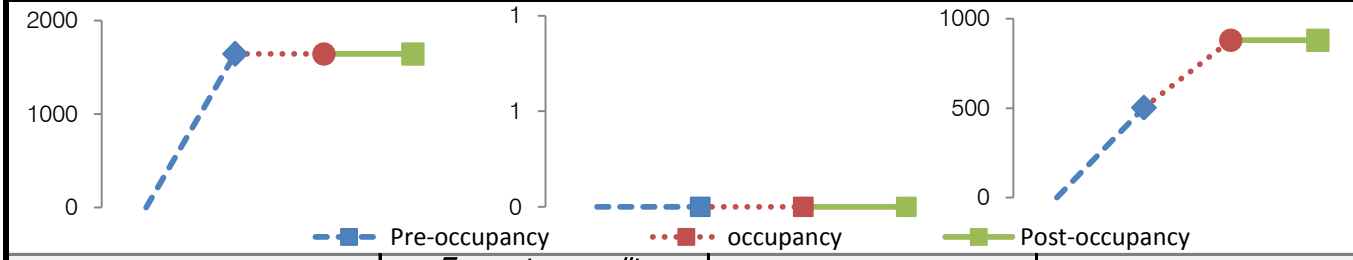


Climate Change Benefits by Category

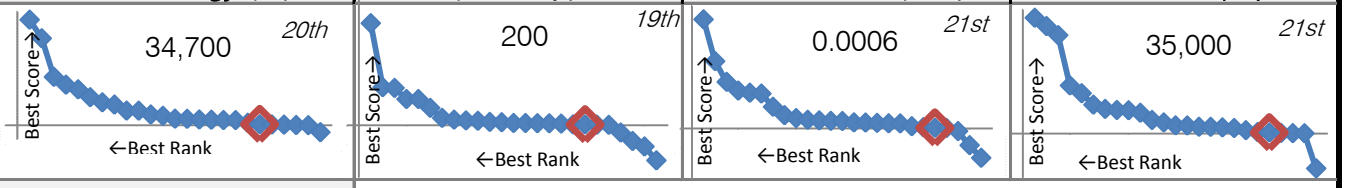


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
34,700 *20th*	200 *19th*	0.0006 *21st*	35,000 *21st*



Comments and uncertainties

Reduced Packaging *Practice #23*

Description of Waste Prevention Practice

Many building materials, like most products, require a significant amount of packaging. In most cases, this packaging is disposed of in the process of construction. There may be possibilities for either reducing the amount of packaging or of using reusable packaging. As our focus is on preventing waste, more recyclable packaging will not be considered.

Description of Stage I Modeling

All packaging weight is decreased by 50%

Environment Grade	Waste Prevention Grade	Feasibility Grade
D	D	C

Summary of Findings

The benefits of reducing packaging are substantially smaller then the majority of other practices considered. Waste prevention and cost are also low.

Recommended Actions

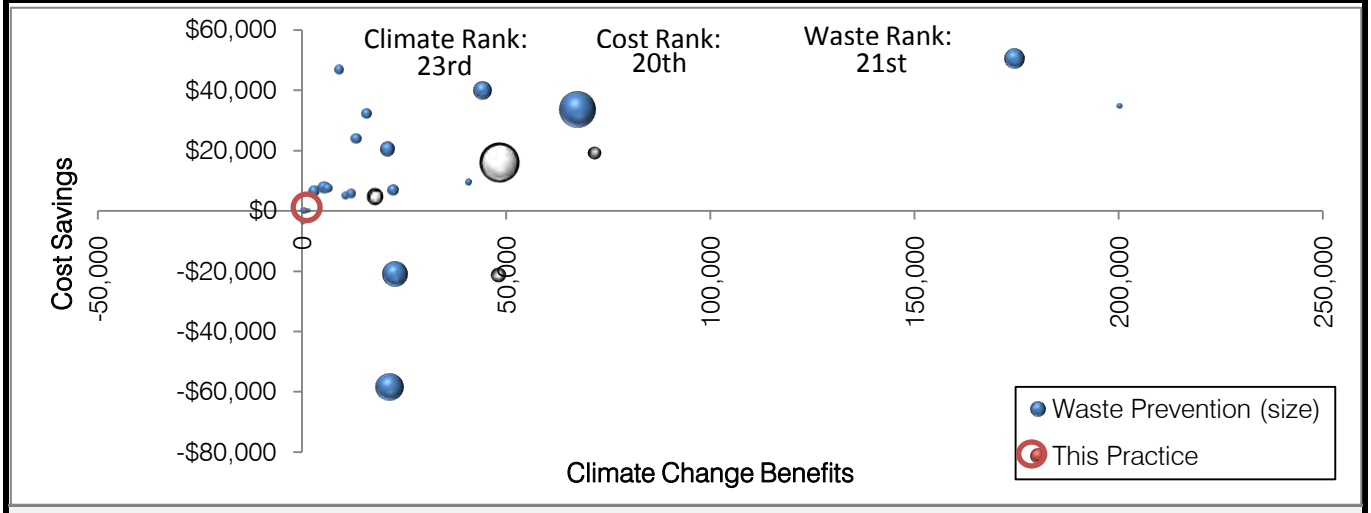
Do not advance to Phase II

Feasibility

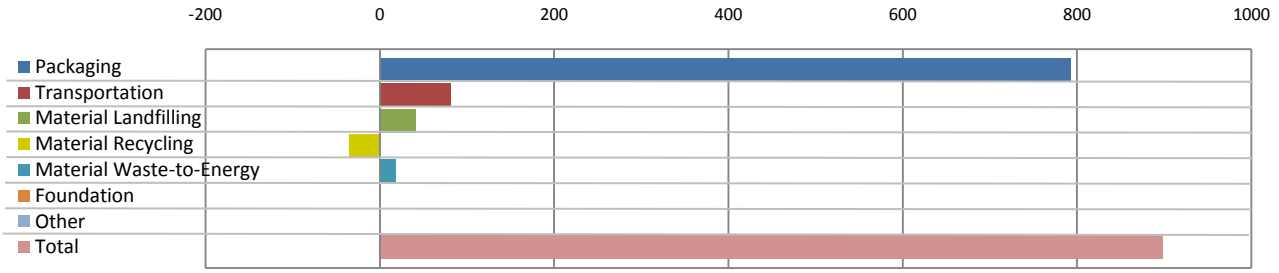
Difficulty to implement	Difficulties in achieving reductions will depend on the material and packaging		
Acceptability to homeowner	No perceived difference		
Acceptability to builder	Highly acceptable		
Potential market penetration	High levels of reductions could be limited by the need for adequate packaging to protect products. It is unclear what percentage of reduction is feasible.		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Equally
Other comments	0		

Reduced Packaging *Practice #23*

Environmental Impacts, Costs and Waste Prevention

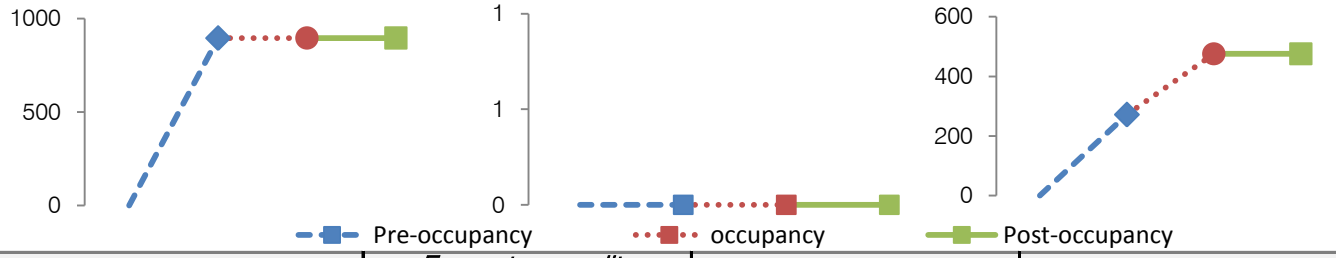


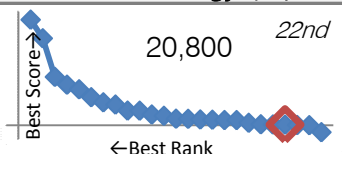
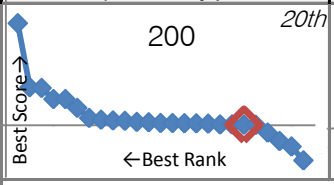
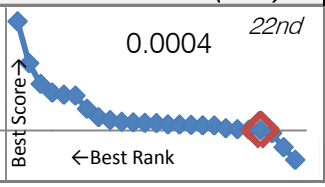
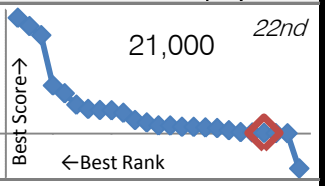
Climate Change Benefits by Category



Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
			

Comments and uncertainties

Dematerialization & Design for Simp. *Practice #24*

Description of Waste Prevention Practice

Dematerializing is a way to use fewer materials to achieve the same desired function of a building component. For instance, many homes now use concrete floors as their finished floor rather than putting additional flooring materials on top. Additionally, an open plan home can lead to a layout that has fewer walls, doors, and other materials. Designing for Simplicity is a practice that eliminates many ornamental aspects of a home design, such as complex shapes, bump-outs, ornate moldings, etc. Non-functional house design elements have the potential to add a significant amount of unnecessary material to homes.

Description of Stage I Modeling

Flooring is removed, moldings and wainscoting is eliminated

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	F	A

Summary of Findings

Use of less materials lead to less impacts at material production and in transportation. The material production benefits are largely offset by losses of beneficial uses of materials at their end-of-life. Cost and Waste rankings are among the middle to lower range.

Recommended Actions

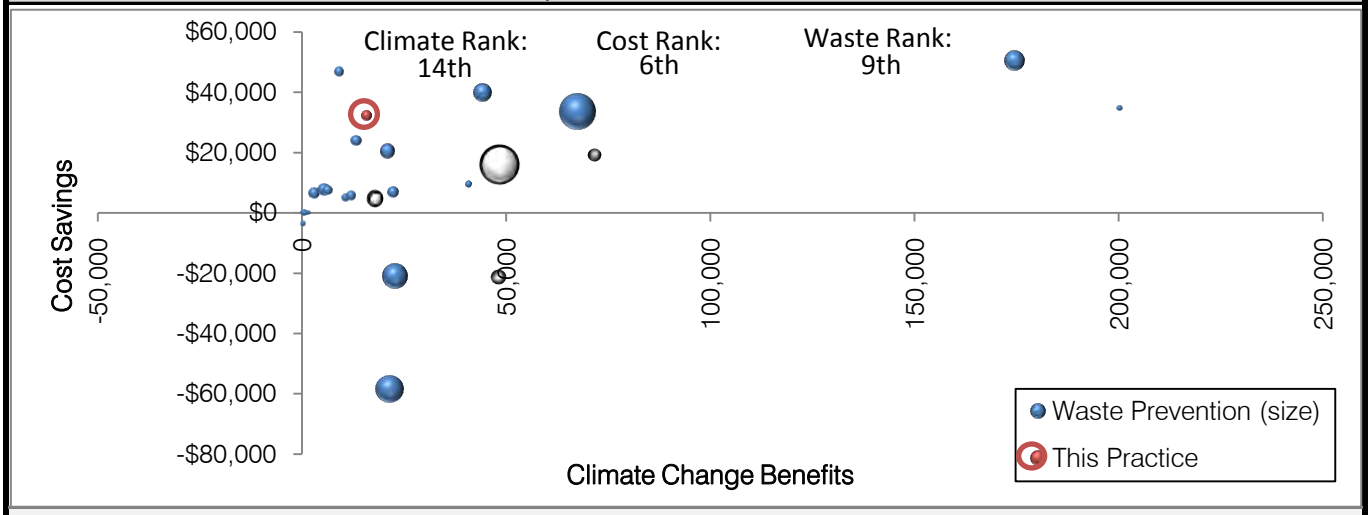
Consider Advancing

Feasibility

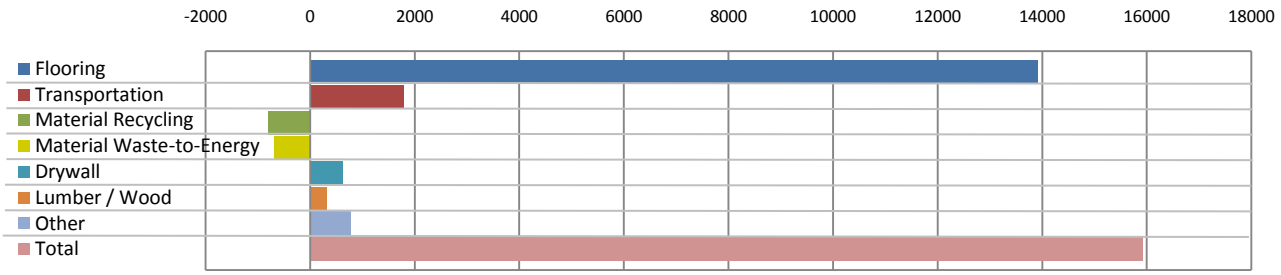
Difficulty to implement	No difficulty		
Acceptability to homeowner	Acceptability will depend on the materials that are removed and the overall aesthetic of the home; some homeowners will be more receptive than others		
Acceptability to builder	Highly acceptable		
Potential market penetration	High penetration is possible, could be limited for market demand		
Applicable to multi-family	Equally		
Applicable to new construction	Equally	*Applicable to existing homes*	Limited to significant renovations / additions
Other comments	0		

Dematerialization & Design for Simp. *Practice #24*

Environmental Impacts, Costs and Waste Prevention

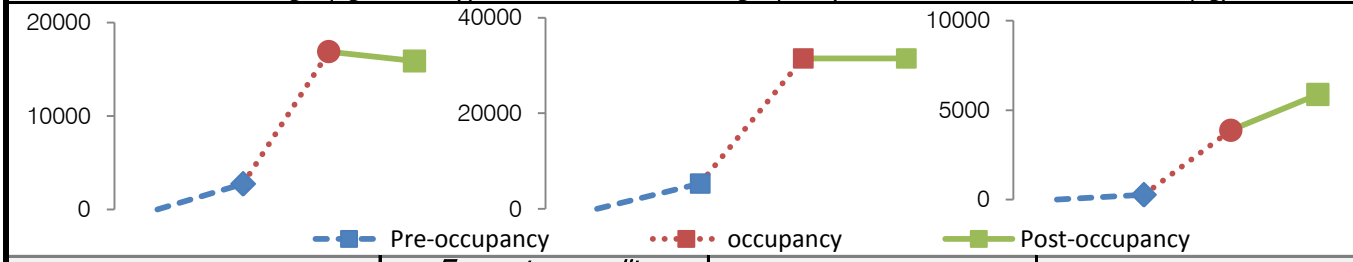


Climate Change Benefits by Category

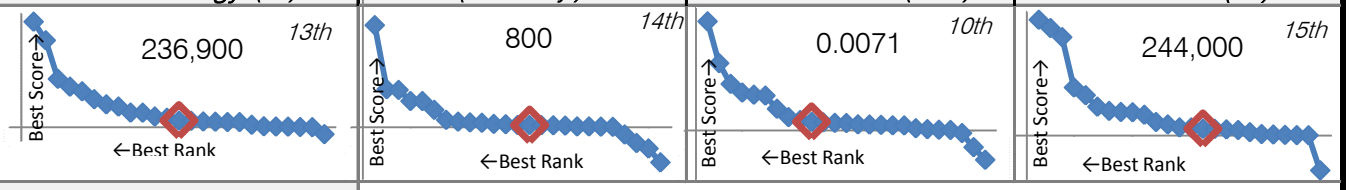


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
236,900 *13th*	800 *14th*	0.0071 *10th*	244,000 *15th*



Comments and uncertainties	Outcomes are subject to assumptions about impacts and benefits and end-of-life, which are highly uncertain for some materials at this stage.

Single-Story Homes *Practice #25*

Description of Waste Prevention Practice

Single-family homes may be single or Single-Story. This configuration affects both the materials used and the energy efficiency of the home.

Description of Stage I Modeling

While the standard home scenario is 2-story single-family residence, a scenario has been made to reflect an equivalent single-story residence. The benefits of this scenario are therefore taken in reverse to determine the benefit of moving from a single to double story home.

Environment Grade	Waste Prevention Grade	Feasibility Grade
C	B	B

Summary of Findings

The movement from single story to Single-Story decreases the area of roof and foundation, which are relatively well insulated, and increases the area of wall, which is poorly insulated. The result is a loss of energy efficiency, more than offsetting the benefits of using less materials.

Recommended Actions

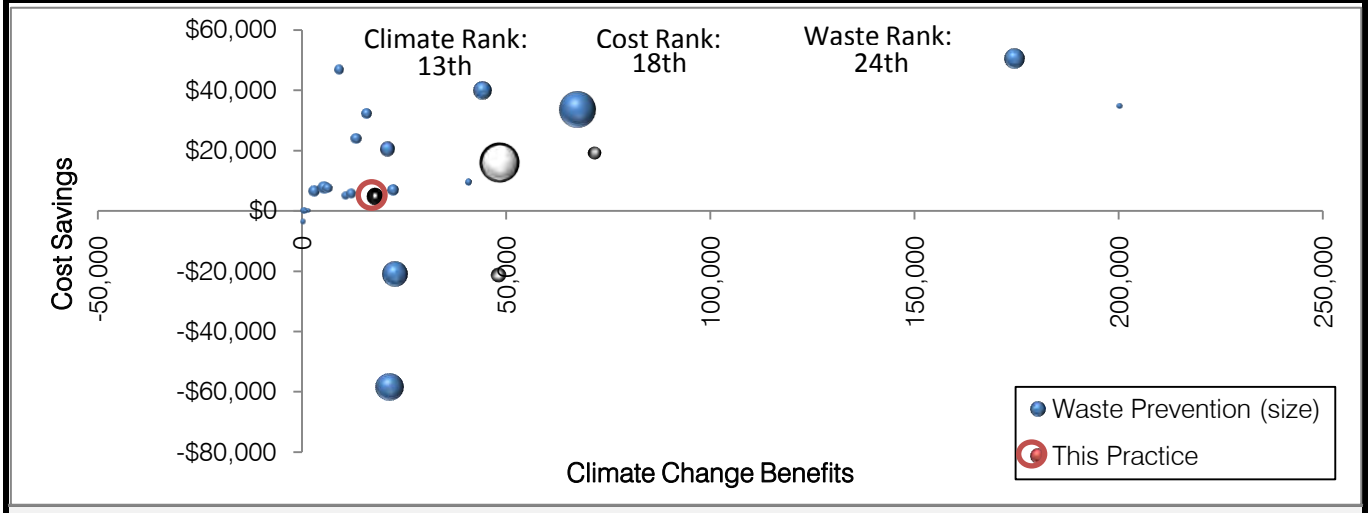
Consider advancing to Phase II, with a wider range of conditions.

Feasibility

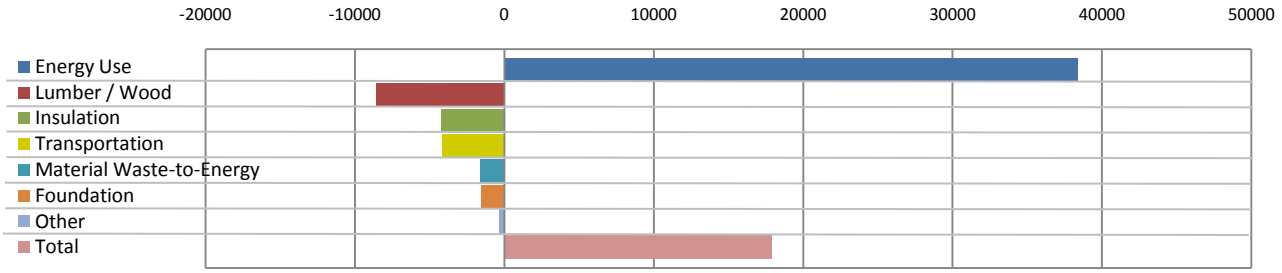
Difficulty to implement	No difficulties		
Acceptability to homeowner	Highly acceptable for most homeowners; some may prefer single-story		
Acceptability to builder	Highly acceptable		
Potential market penetration	High penetration, may be limited by preferences of some homeowners		
Applicable to multi-family	Not applicable (most or all multi-family will already be Single-Story)		
Applicable to new construction	Fully applicable	*Applicable to existing homes*	Not applicable
Other comments	0		

Single-Story Homes *Practice #25*

Environmental Impacts, Costs and Waste Prevention

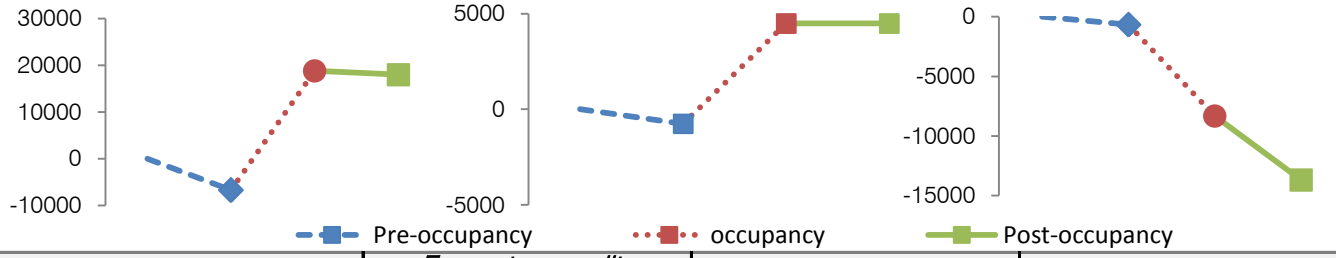


Climate Change Benefits by Category

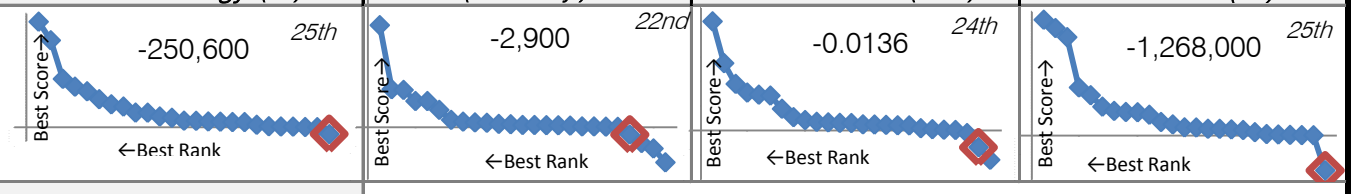


Time Progression:

Climate Change (kg CO2 Eq.) *Cost Savings (USD)* *Waste Prevention (kg)*



Non-Ren. Energy (MJ)	*Ecosystem quality (PDF*m2*yr)*	*Human health (DALY)*	*Resources (MJ)*
-250,600 *25th*	-2,900 *22nd*	-0.0136 *24th*	-1,268,000 *25th*



Comments and uncertainties	A greater amount of insulation in the walls could substantially change the outcomes of this scenario.