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A Life Cycle Approach to Waste Prevention from the Oregon Residential Construction Sector



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State of Oregon
Department of
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Research Partners



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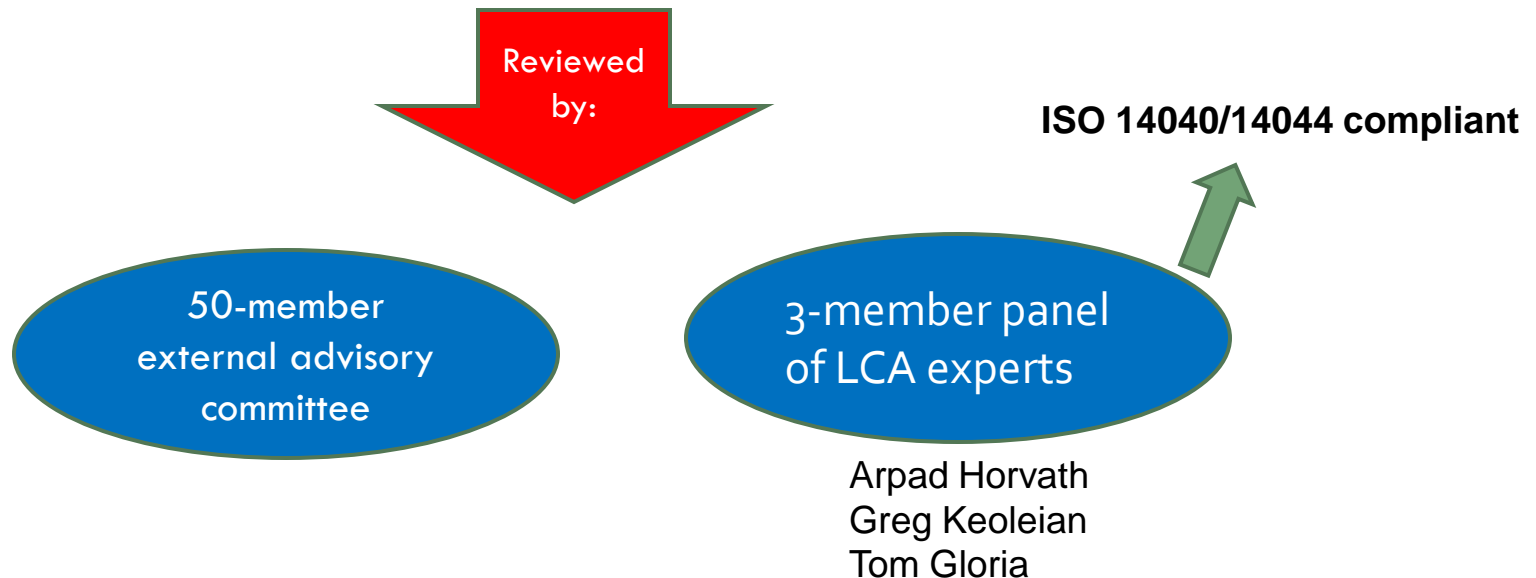
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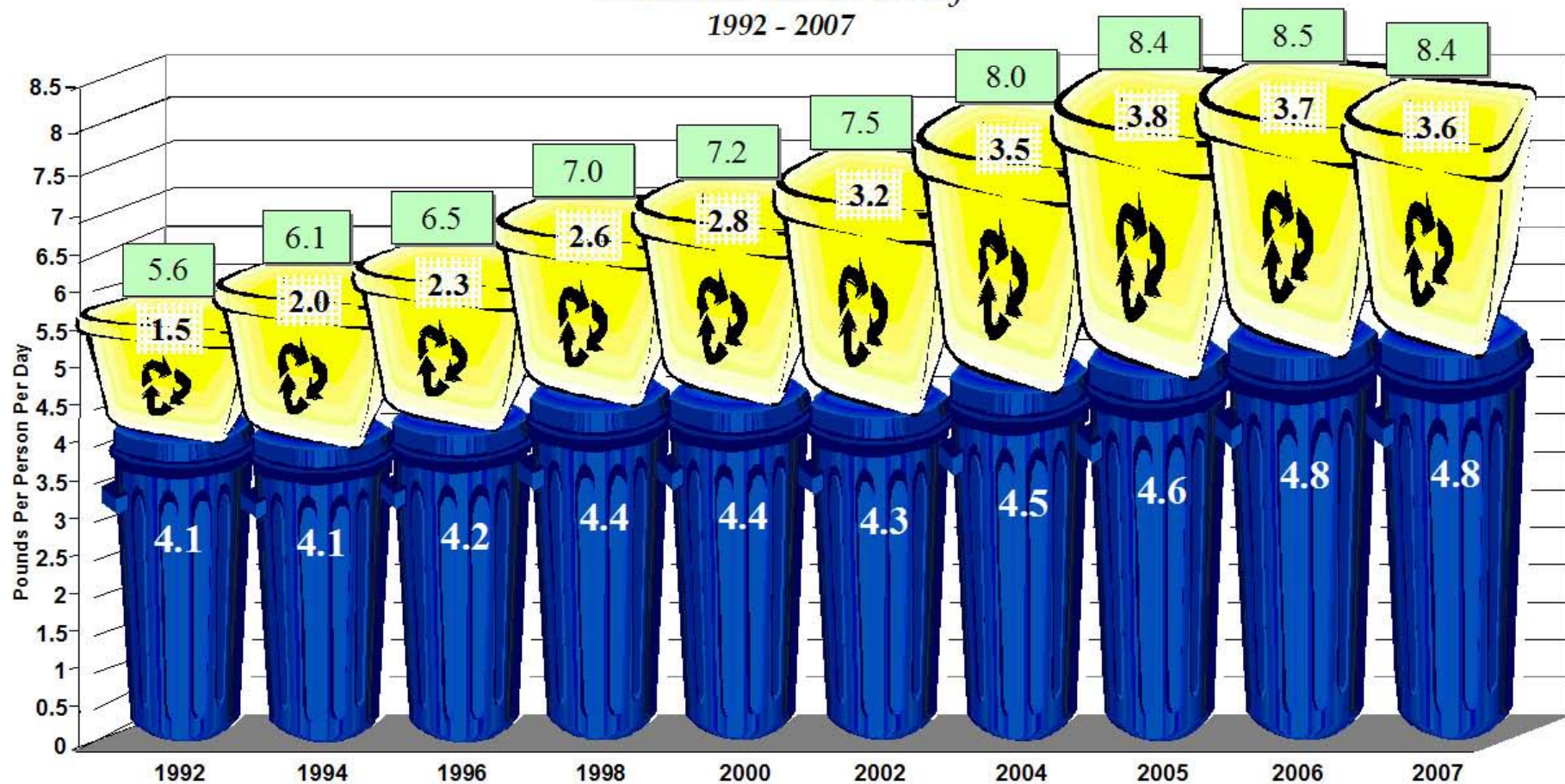


Oregon Solid Waste Disposed, Recovered, and Generated



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*Total Solid Waste Disposed, Recovered, and Generated
Pounds Per Person Per Day
1992 - 2007*



Recovery + Disposal = Generation

Key

0.0 = Generated



= Recovered



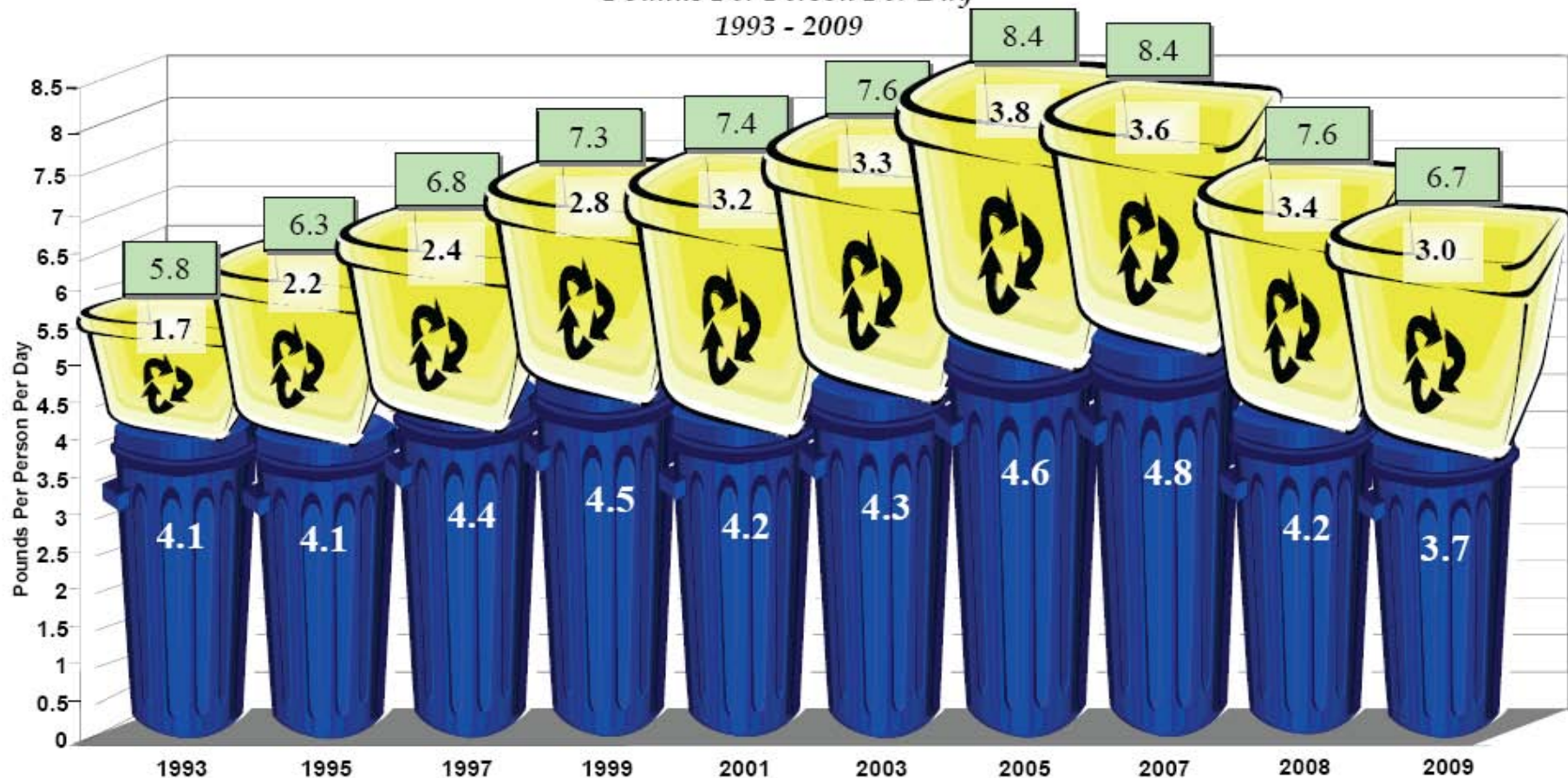
= Disposed

Oregon Solid Waste Disposed, Recovered, and Generated



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*Total Solid Waste Disposed, Recovered, and Generated
Pounds Per Person Per Day
1993 - 2009*



Recovery + Disposal = Generation

Key

0.0 = Generated



= Recovered



= Disposed

Focus Area – residential waste prevention

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Reduce

**waste
prevention**

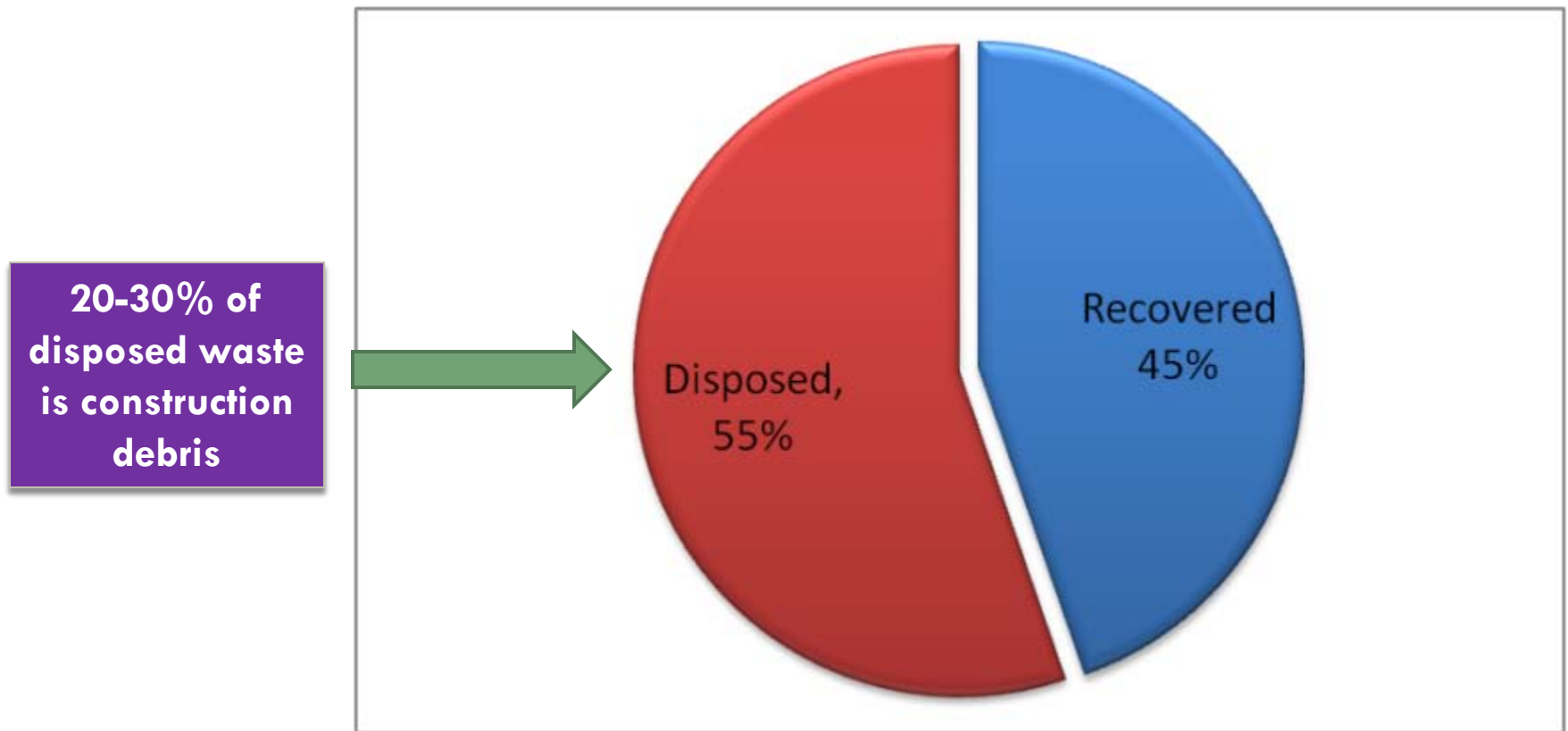
Reuse

Recycle



Waste Disposal and Recovery

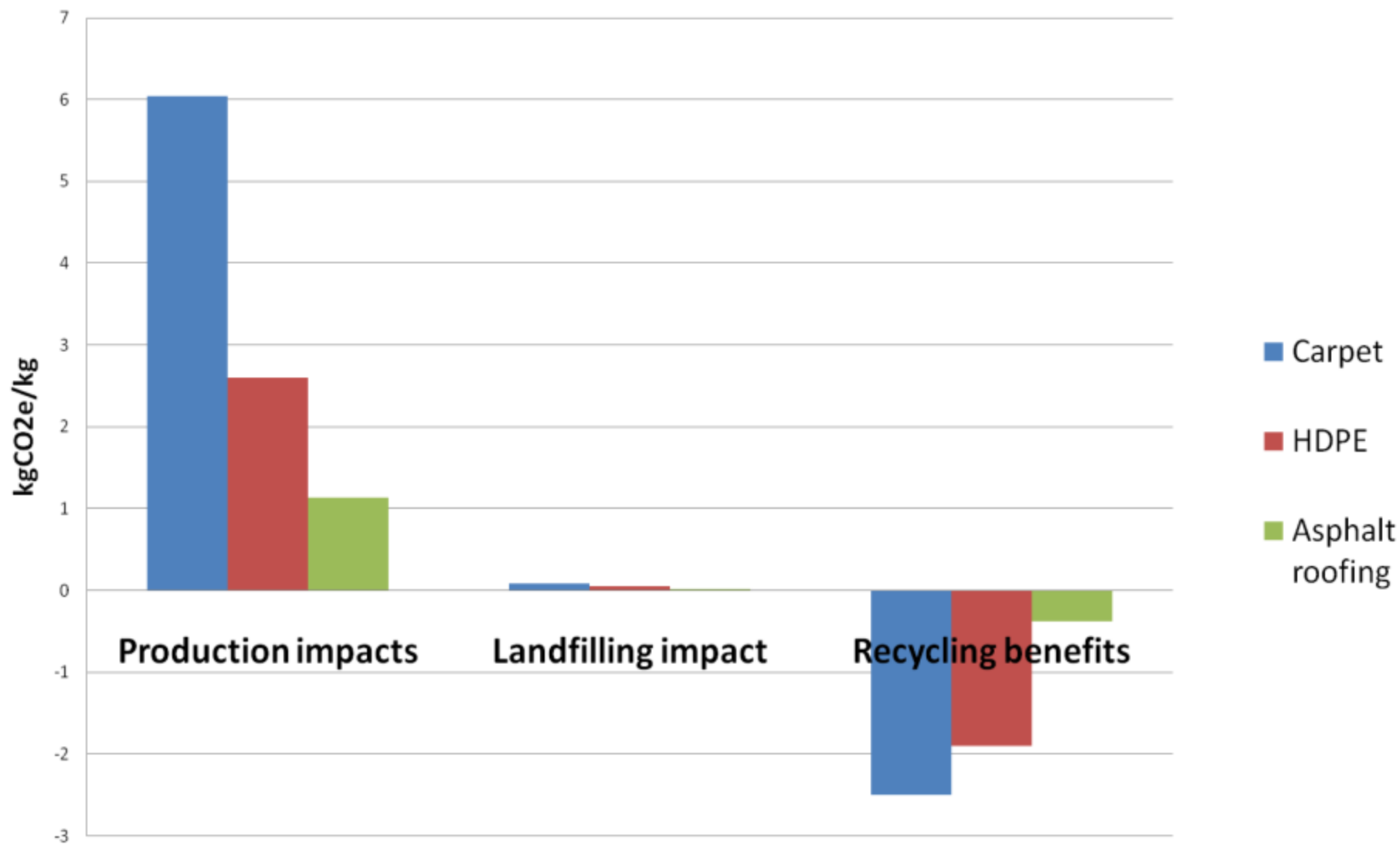
2009 Oregon Waste Generation = 4.6 million tons



Greenhouse Gas emissions from Production, Landfill, and Recycling



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Initial Study Question

Over the life of a home,
how can you use fewer
building materials or
reuse materials?



Waste Prevention Practices Evaluated

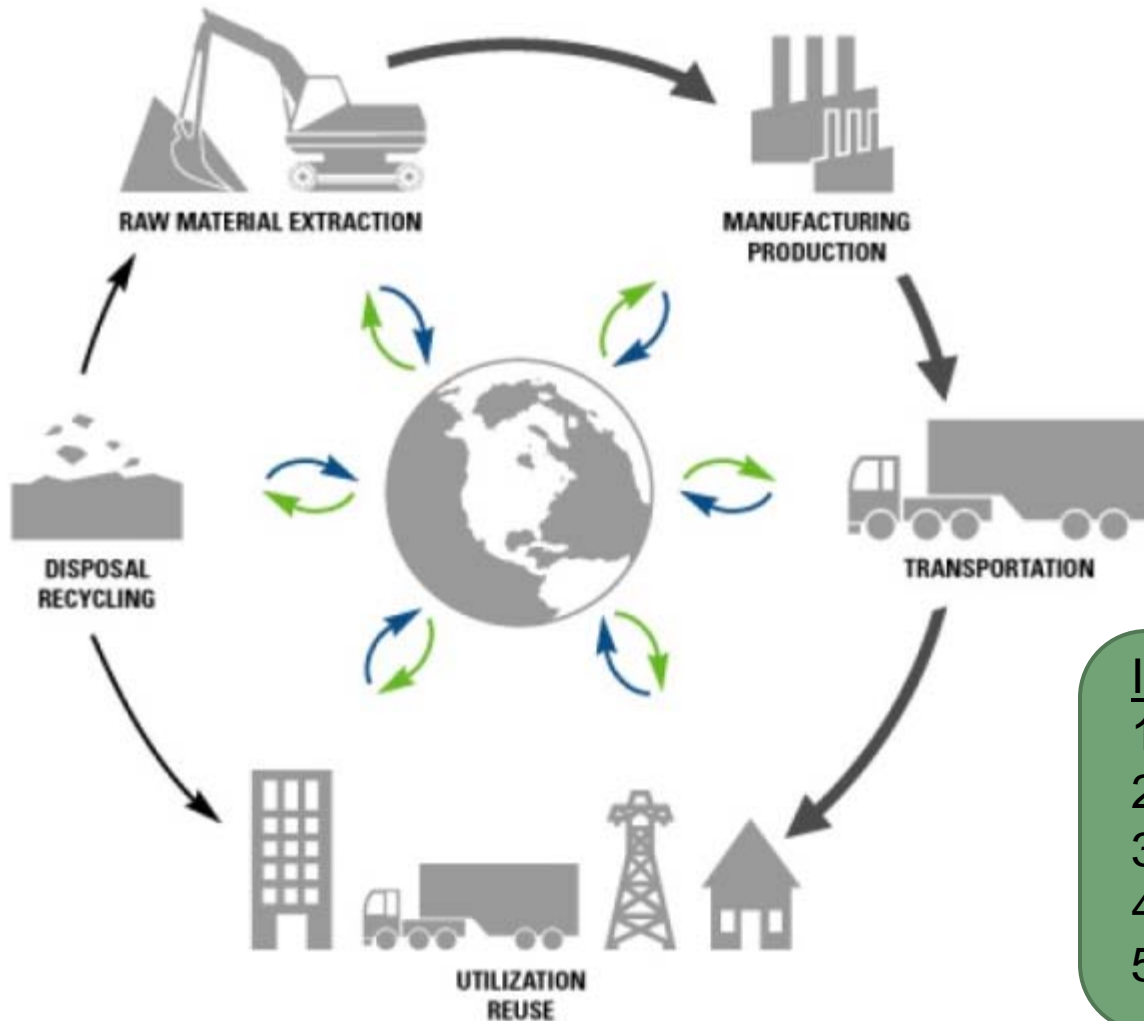


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- ❑ Intermediate Framing
- ❑ Advanced Floor Framing
- ❑ Advanced Framing (w/ drywall clips)
- ❑ Smaller Homes
- ❑ Insulating Concrete Forms
- ❑ Structural Insulated Panels
- ❑ Strawbale w/ timber frame
- ❑ Adaptability: Design for Disassembly
- ❑ Adaptability: Utility Chase
- ❑ Dematerializing and Design for Simplicity
- ❑ Design using Salvaged Materials
- ❑ Adaptability: Reduced Remodeling
- ❑ Design using Salvaged Materials
- ❑ Homeowner Maintenance Training
- ❑ Restoration
- ❑ Multifamily Housing
- ❑ Thermal Curtains
- ❑ Reusable Packaging
- ❑ Reduced Packaging
- ❑ Single-story Homes
- ❑ Detailed Framing Cut List
- ❑ Offsite Prefabricated Components
- ❑ Flashing and Rainscreening
- ❑ Deconstruction
- ❑ Durable roofing, siding and flooring

Lifecycle Analysis

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Climate Change Impacts were used as the prioritizing criterion in this study.

Impact categories (selection):

1. Energy used
2. Greenhouse gas emissions
3. Ecotoxicity
4. Human Health
5. Respiratory

Standard Home

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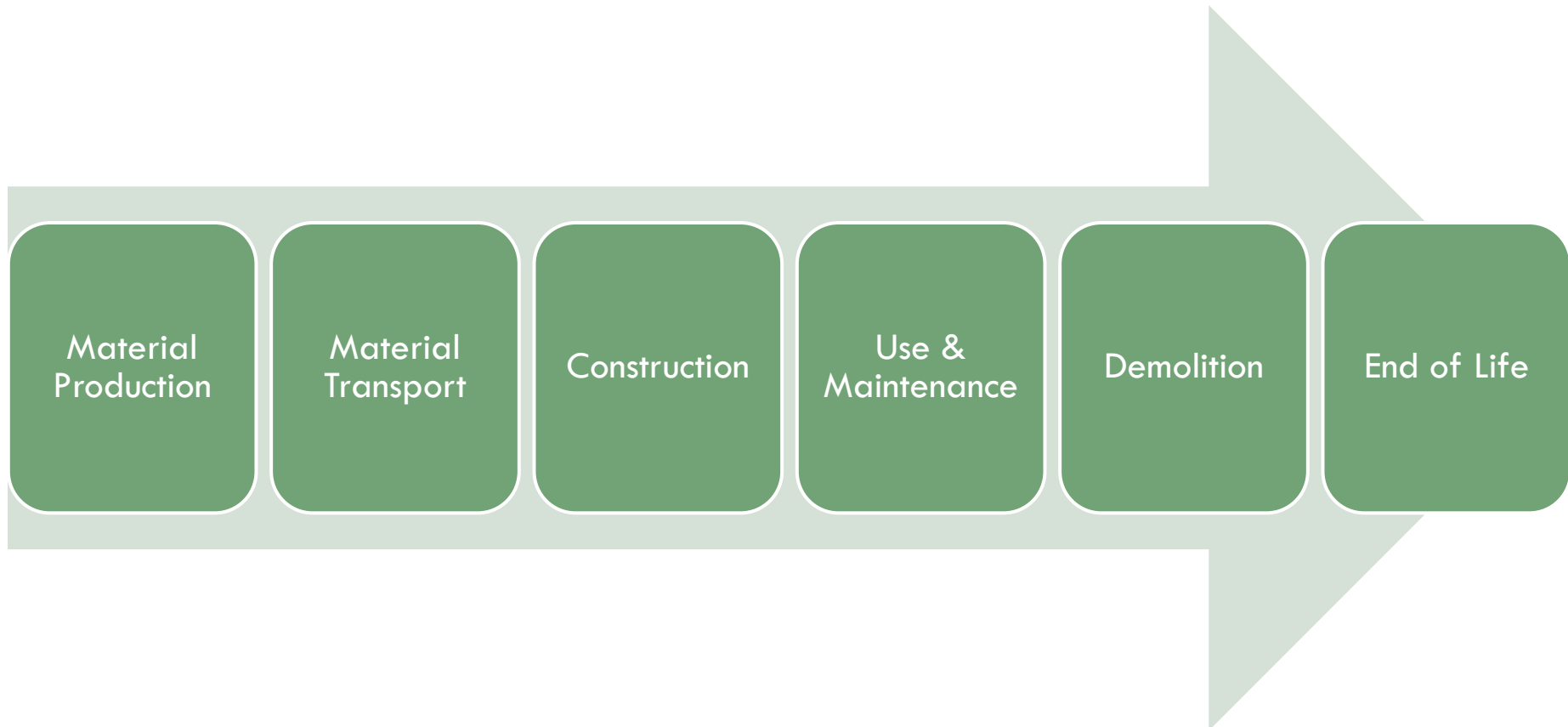
- 2262 sq.ft
- 3 br
- 2 baths
- 2 car garage
- Stem wall foundation
- Post and Beam floor system
- 16inch stud spacing
- Vinyl windows
- Asphalt roof
- Gas furnace, no A/C
- Designed to 2008 Oregon energy code
- Energy use modeled for Portland, OR climate



*****Lifetime = 70 years*****

Evaluating Lifecycle Impacts/Benefits

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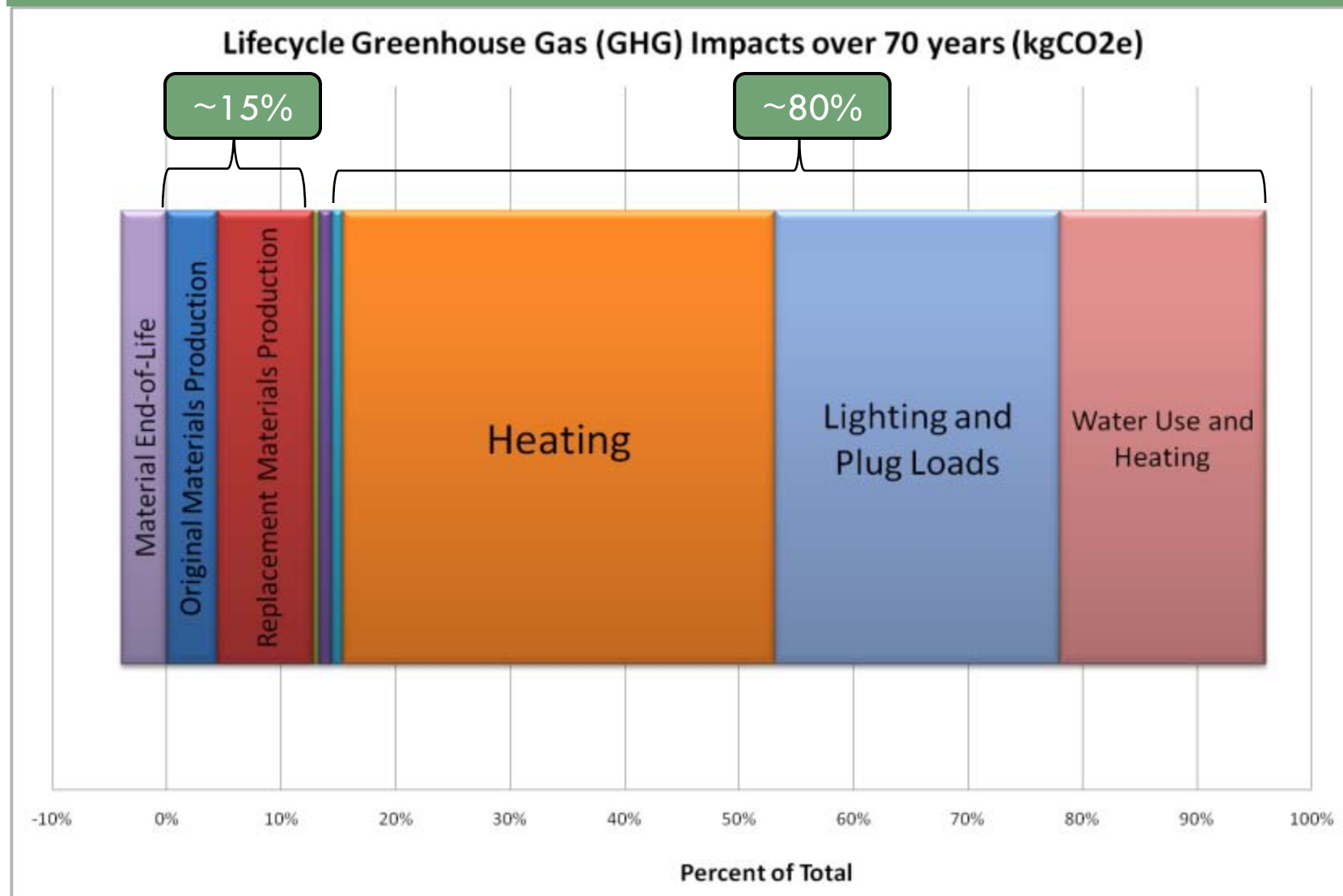


Standard Home Results

Lifecycle greenhouse gas impacts (GHG) of a standard newly constructed OR home



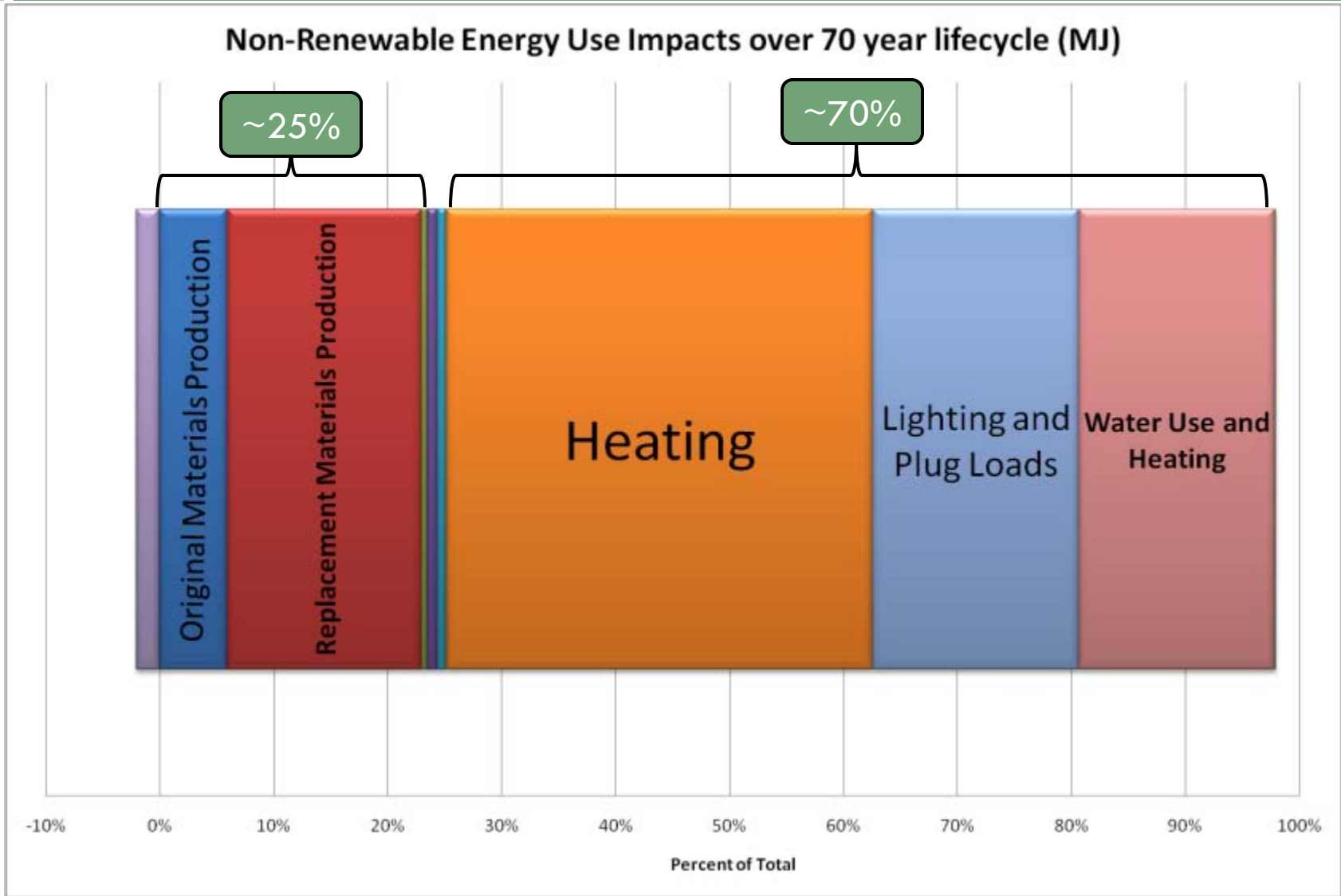
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Lifecycle non-renewable energy impacts of a newly constructed OR home



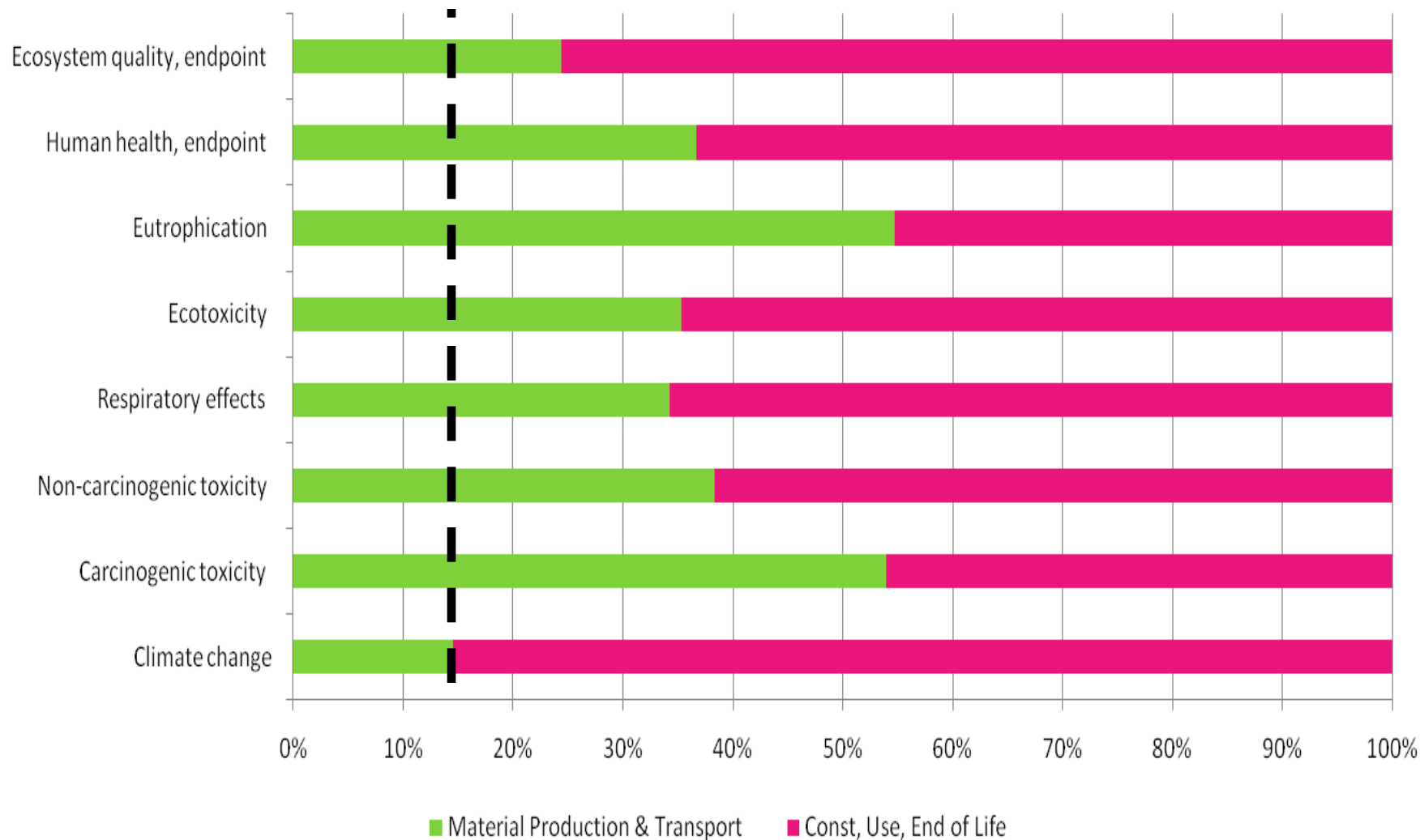
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Environmental impacts of a standard newly constructed OR home over 70 years



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Material-related GHG impacts of an average Oregon home



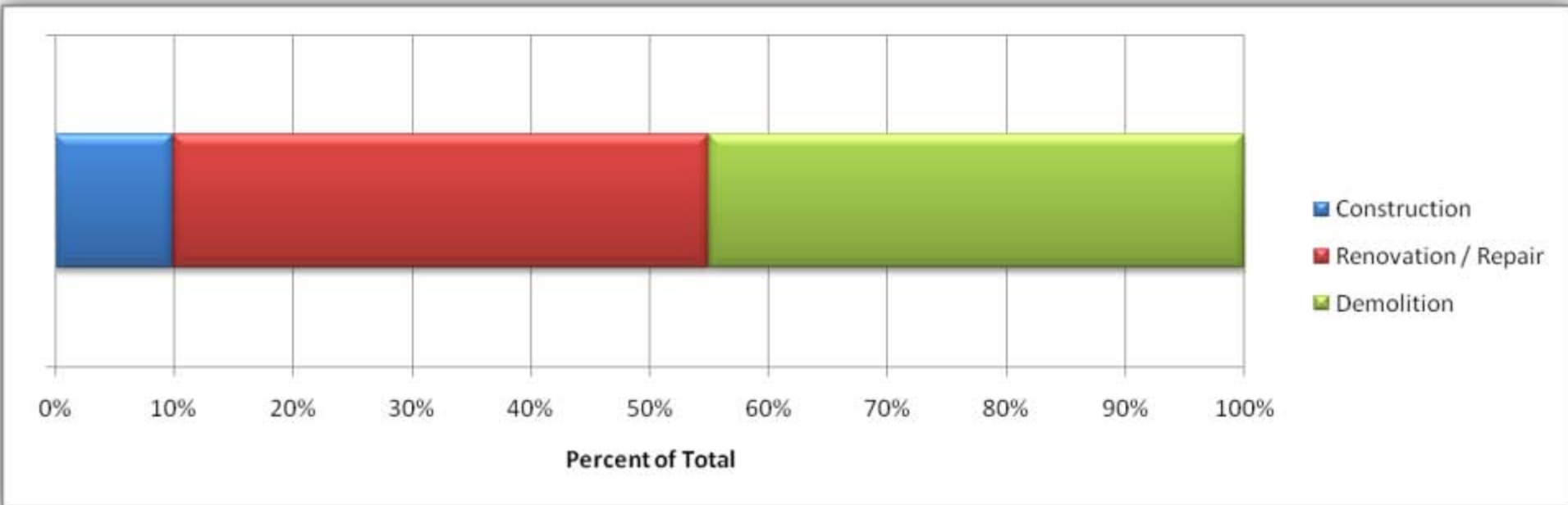
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Climate Change Impact of Materials by Lifecycle Stage (kgCO₂e)



Waste Generation and Material Recovery*

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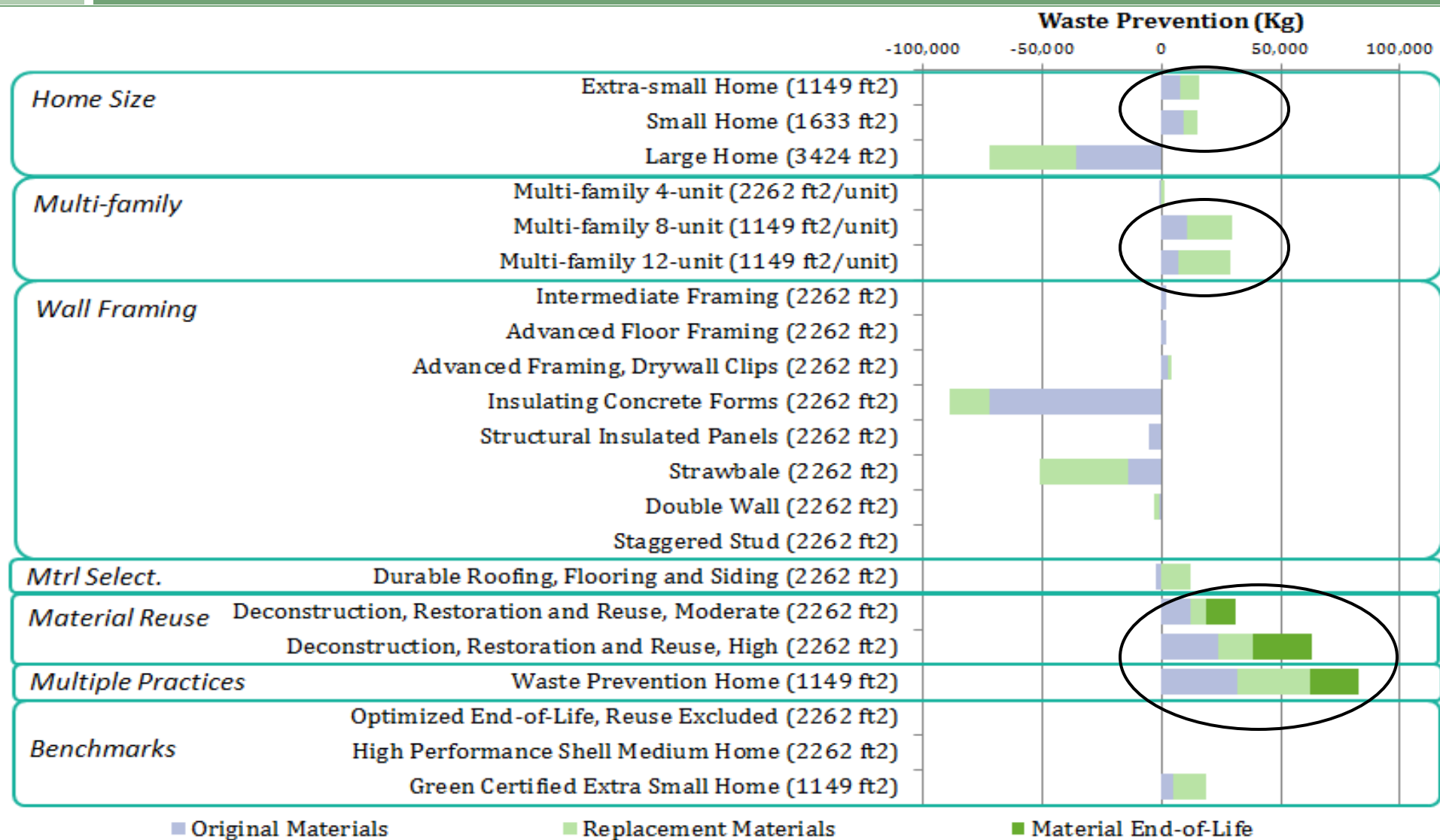


*70 year lifetime

Questions?

Results for practices evaluated against the standard home

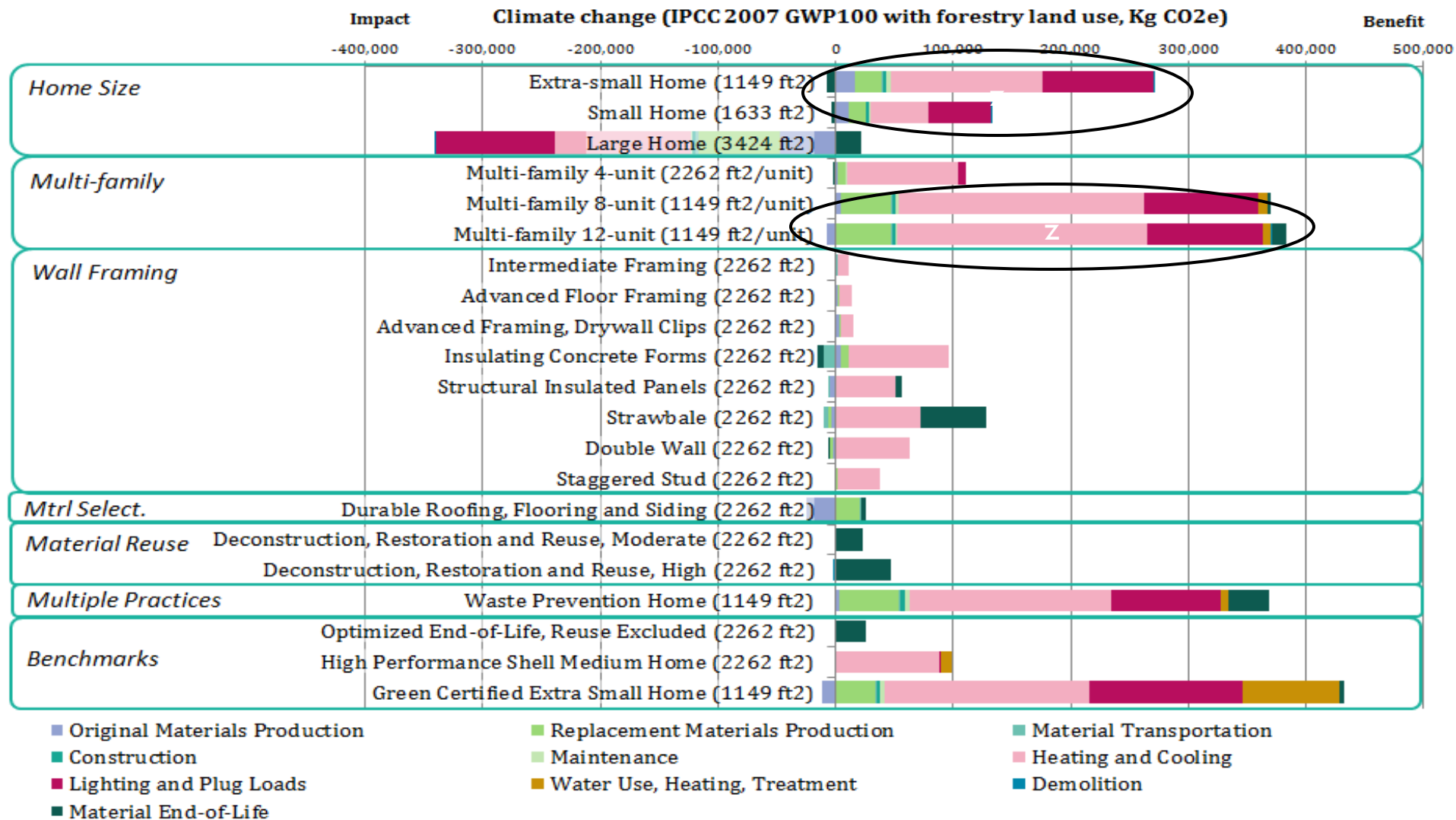
Waste Prevented



Greenhouse gas reductions



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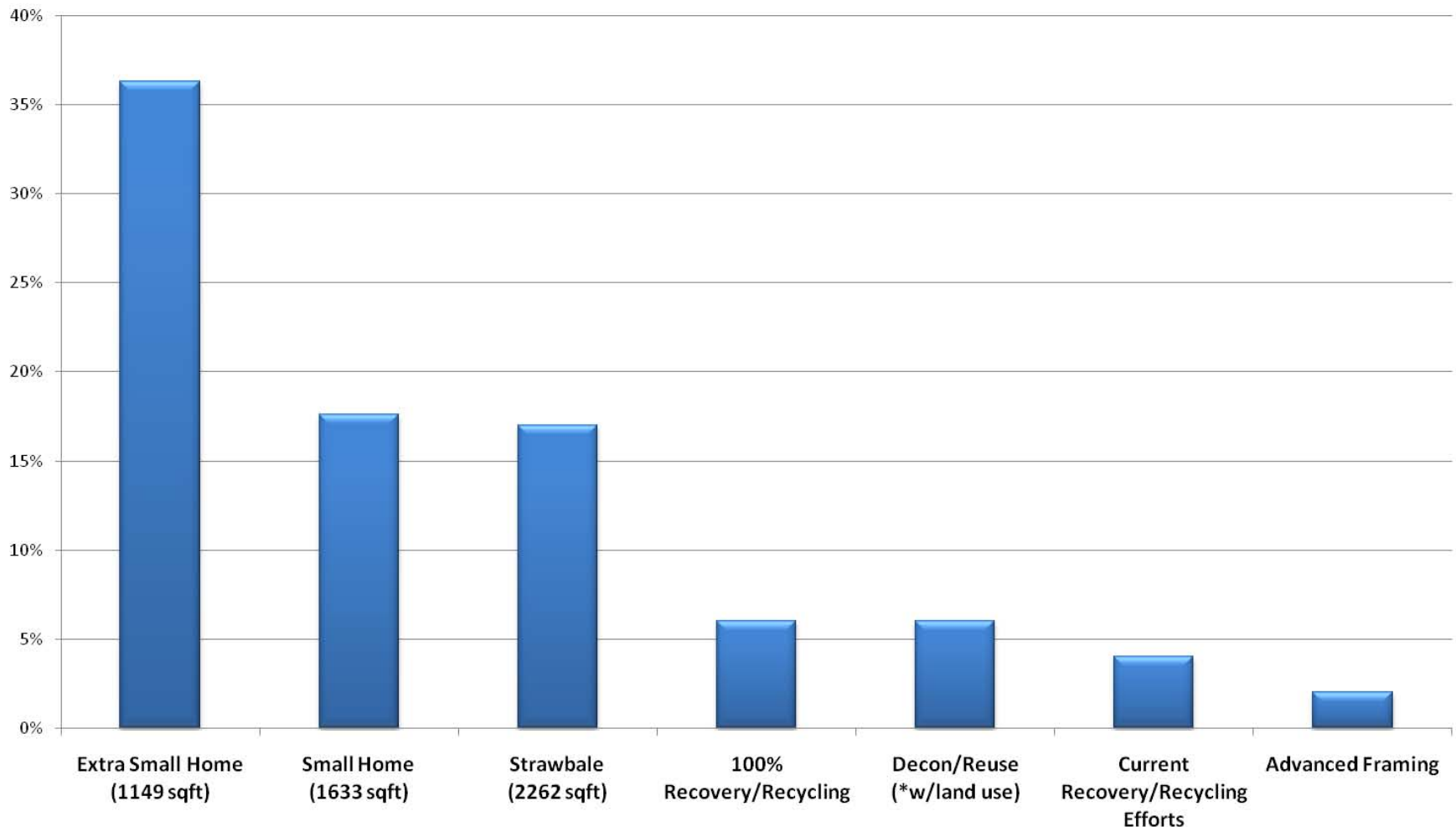


Practices evaluated against the Standard Oregon home



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Reduction in Lifecycle GHG Emissions Compared to the Standard OR Home (2262 sqft)

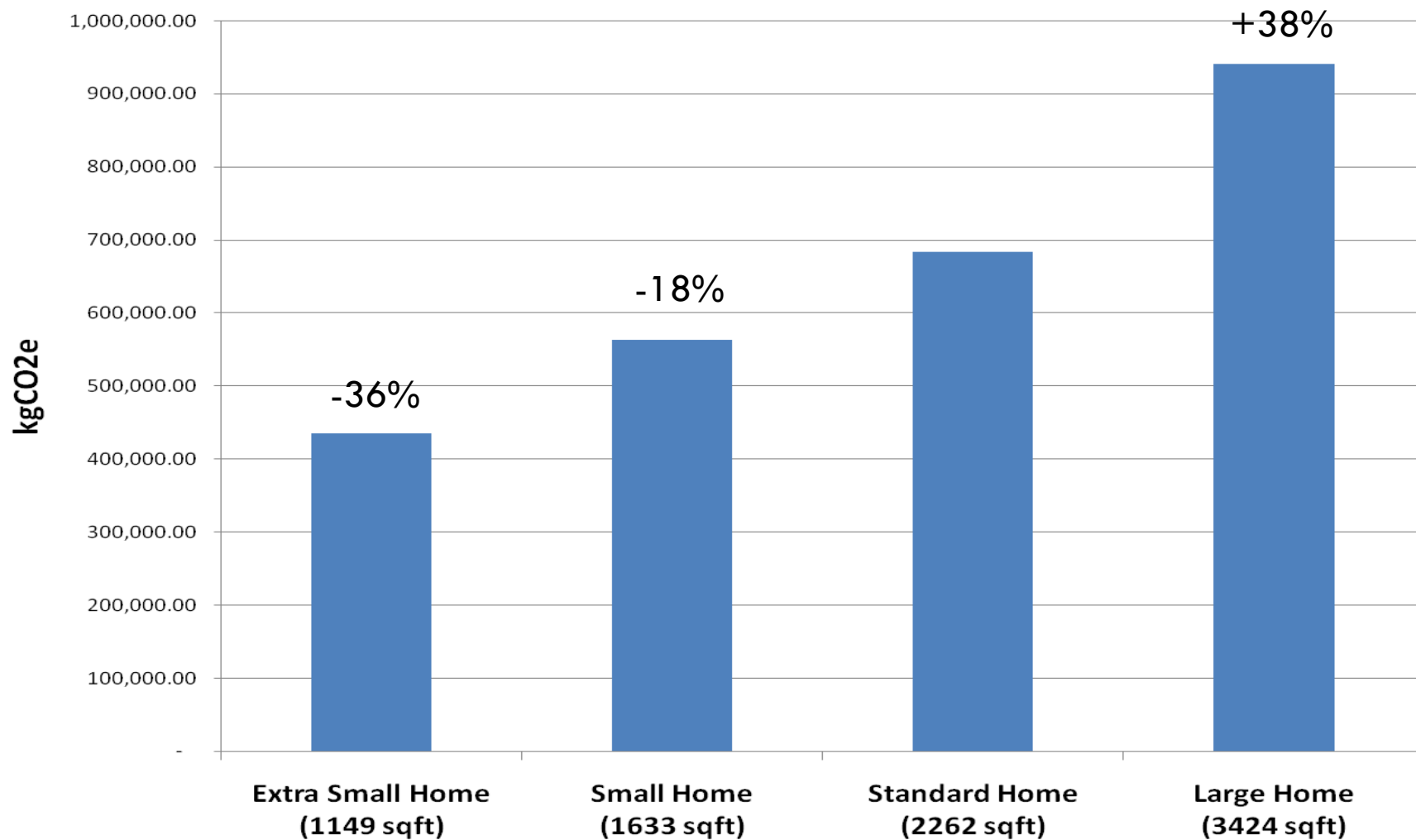


Size Matters



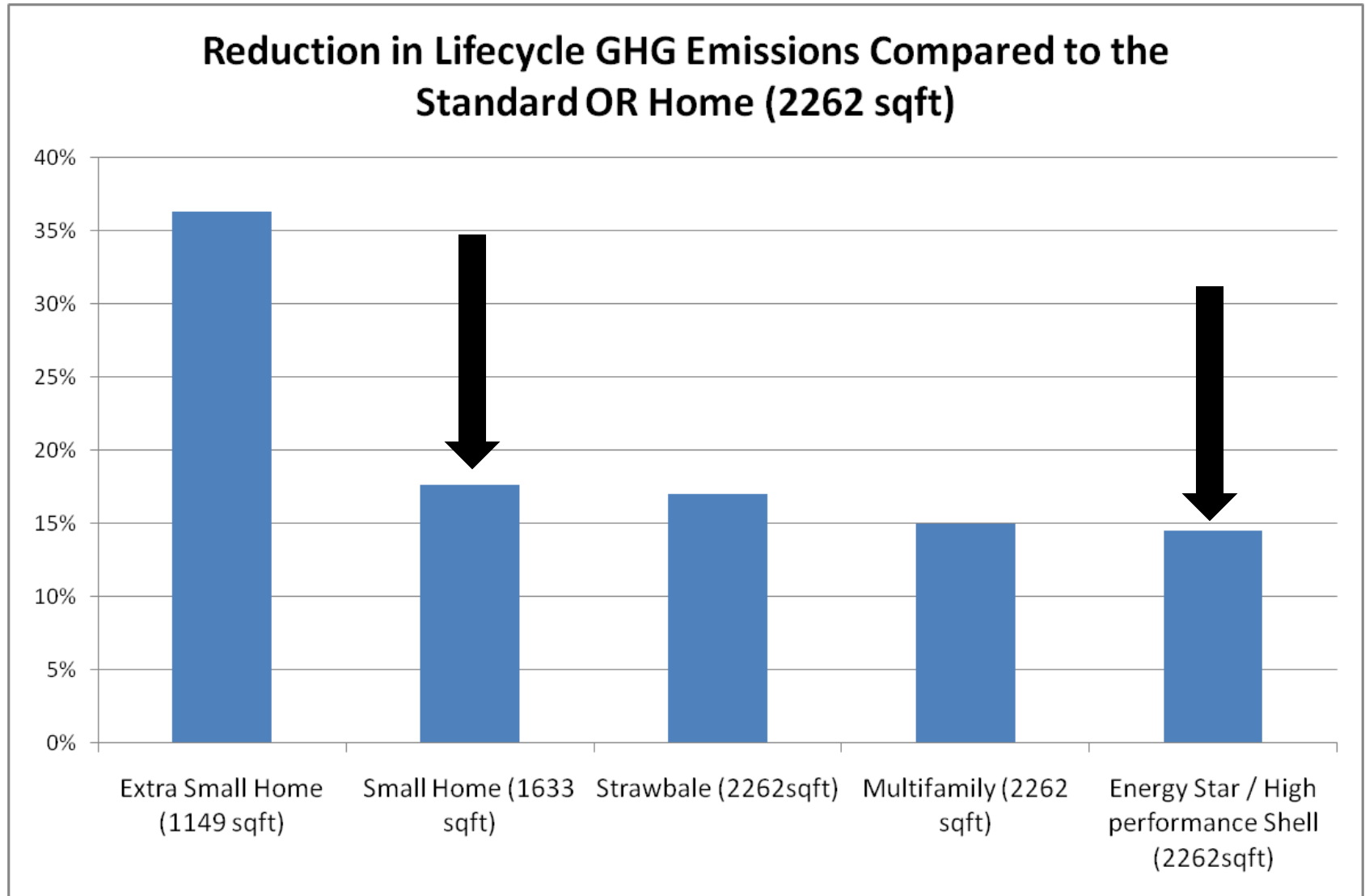
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Lifecycle GHG emissions



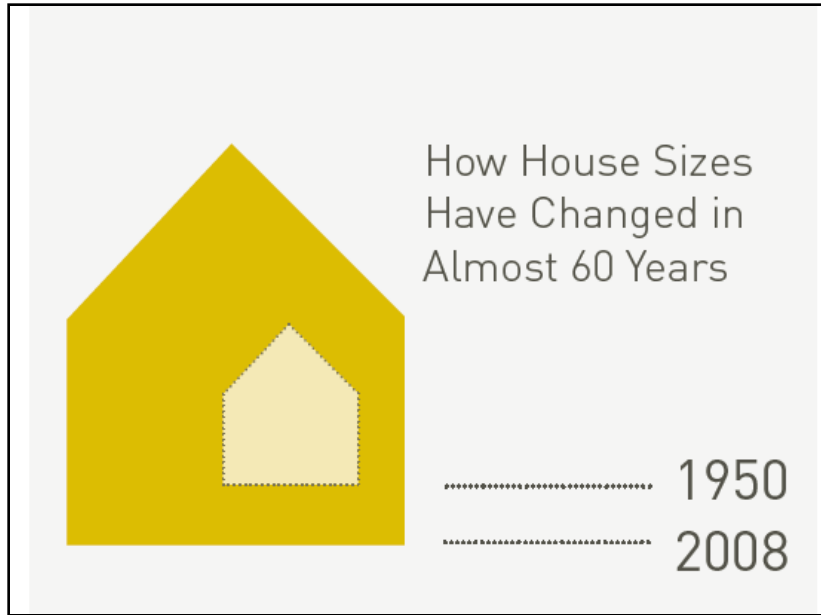
Small is efficient

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Home size increase

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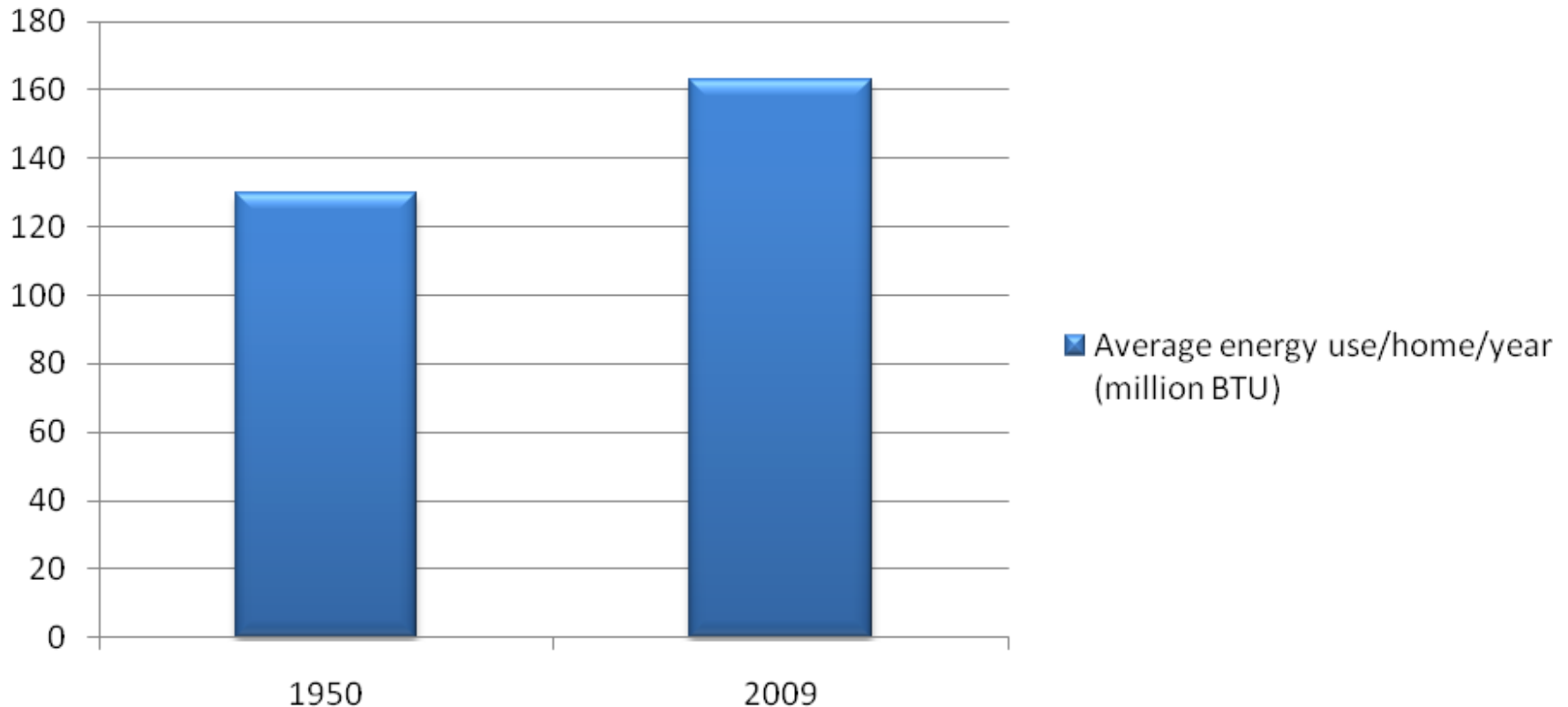


YEAR	HOME SIZE	FAMILY SIZE	SQ. FT. PER PERSON
1950	983	3.8	258.7
2008	2500	2.6	961.5

Home Energy Use – 1950 – 2009

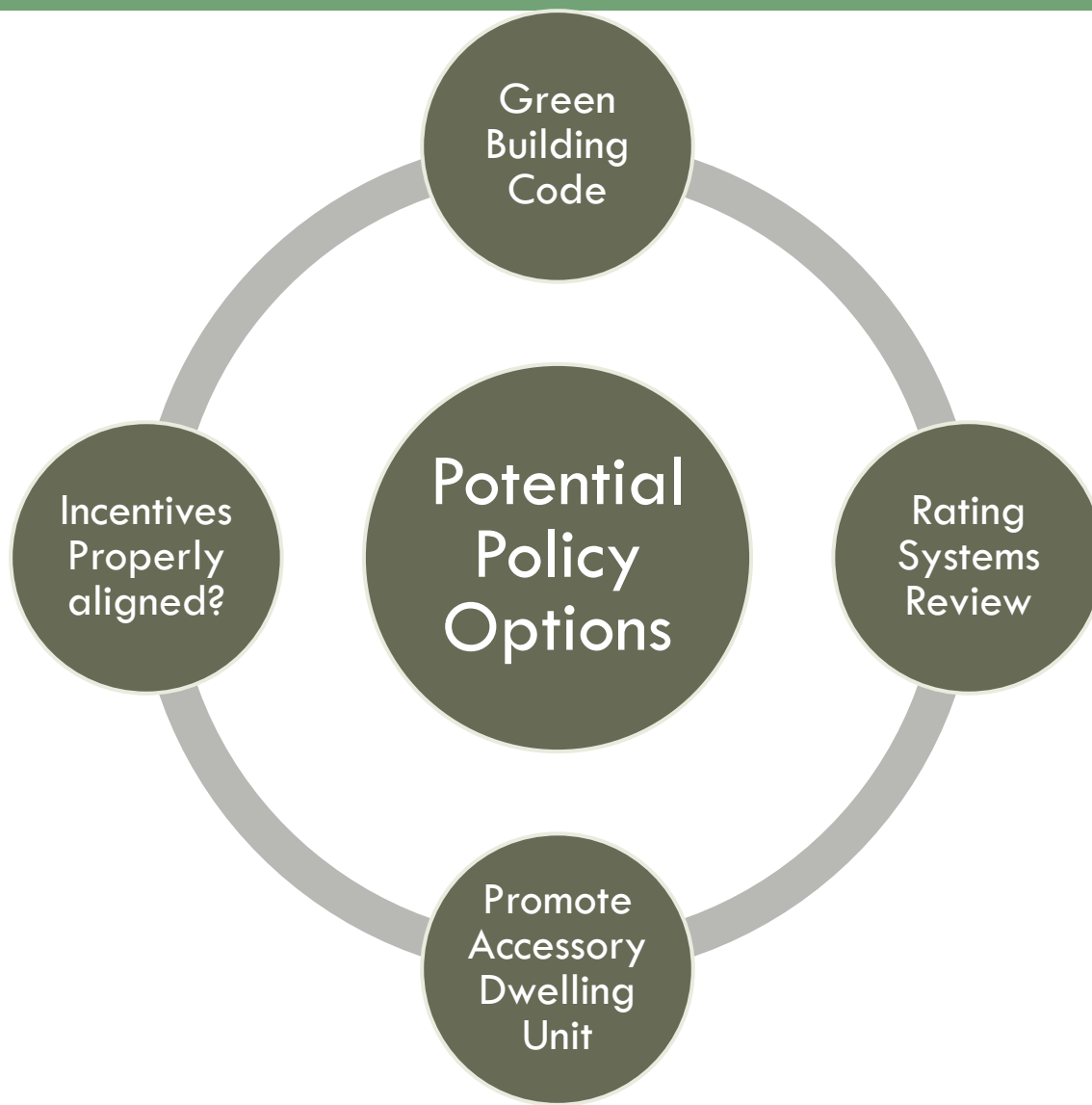
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Average energy use/home/year (million BTU)



Source: Census and EIA

Small Homes



Accessory Dwelling Unit (ADU) Potential

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Accessory Dwelling Units

Infographic by Ryan Sullivan / www.pasteinplace.com

LIVE RENT

Design guidelines for size

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Sizing Guidelines

The chart below establishes a set of size-per-occupant guidelines for green homes.

NUMBER OF OCCUPANTS	GREEN SIZE (SF)	YELLOW SIZE (SF)	WHERE RED SIZE STARTS (SF)
1	200 - 600	600 - 800	800 +
2	400 - 1200	1200 - 1600	1600 +
3	600 - 1600	1600 - 2400	2400 +
4	1000 - 2100	2100 - 2800	2800 +
5	1200 - 2500	2500 - 3200	3200 +
6	1500 - 2800	2800 - 3600	3600 +
7	1800 - 3200	3200 - 4000	4000 +
8	2200 - 3600	3600 - 4400	4400 +

Integrating “Small” into Existing Homes

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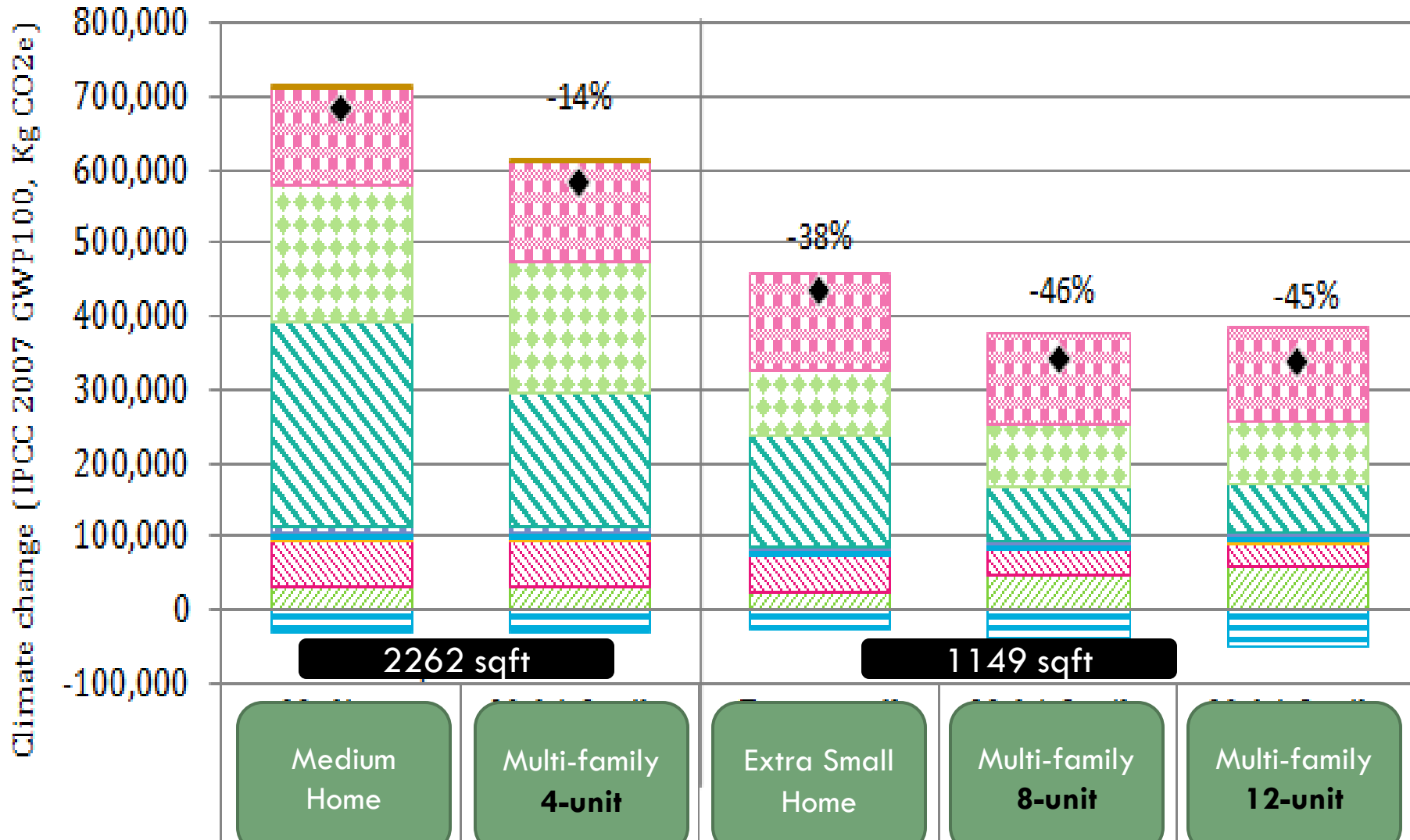
- Get a roommate!
- Forgo additions – redesign space for functionality and needs
- Home office telecommuting
- Rezone as duplex?

- Build internal/external ADU
 - Update energy efficiency during remodel
 - Value added
 - Rental income potential



Multi-family homes show GHG benefit

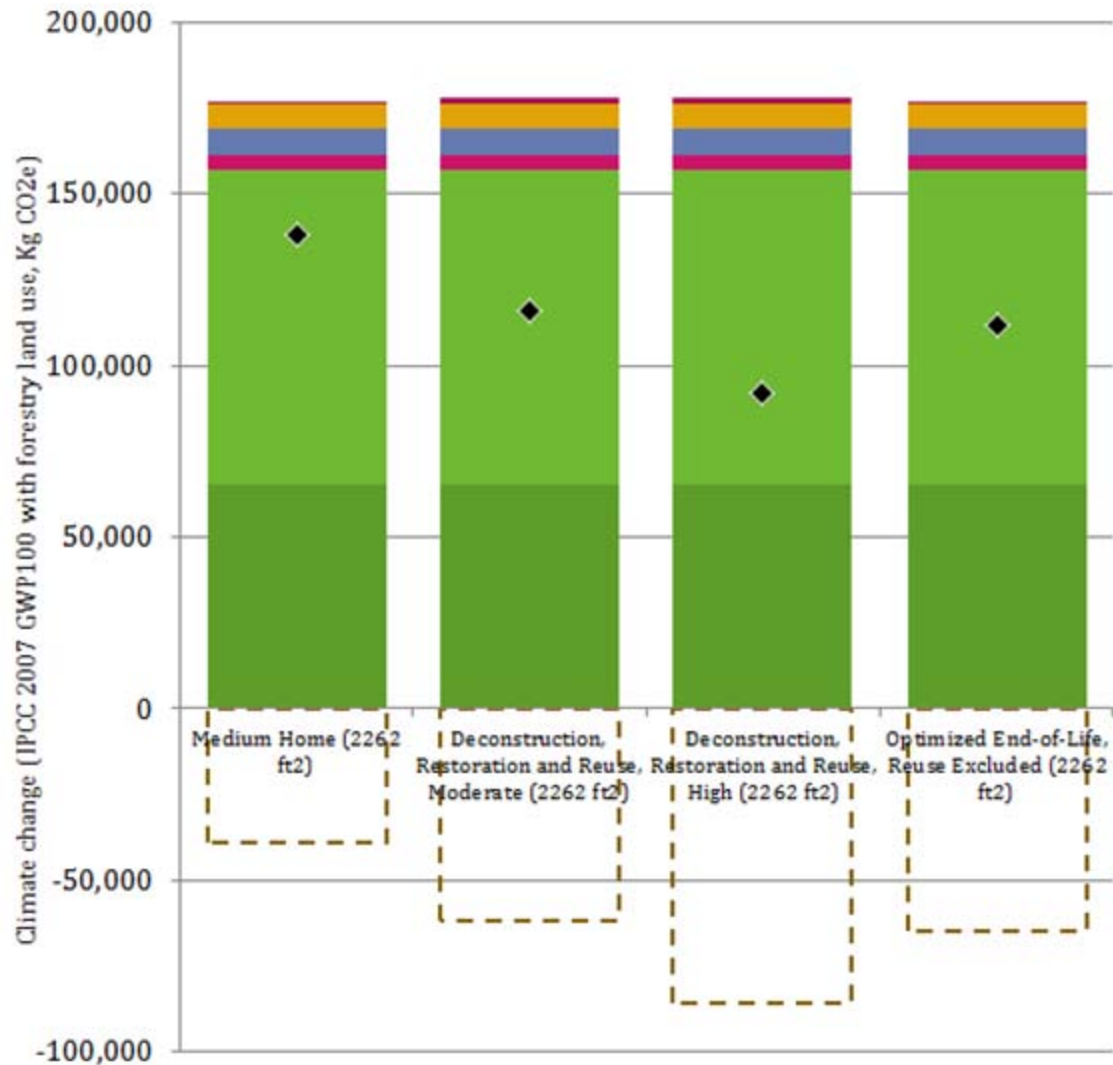
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Materials Reuse offers a substantial reduction in material impact

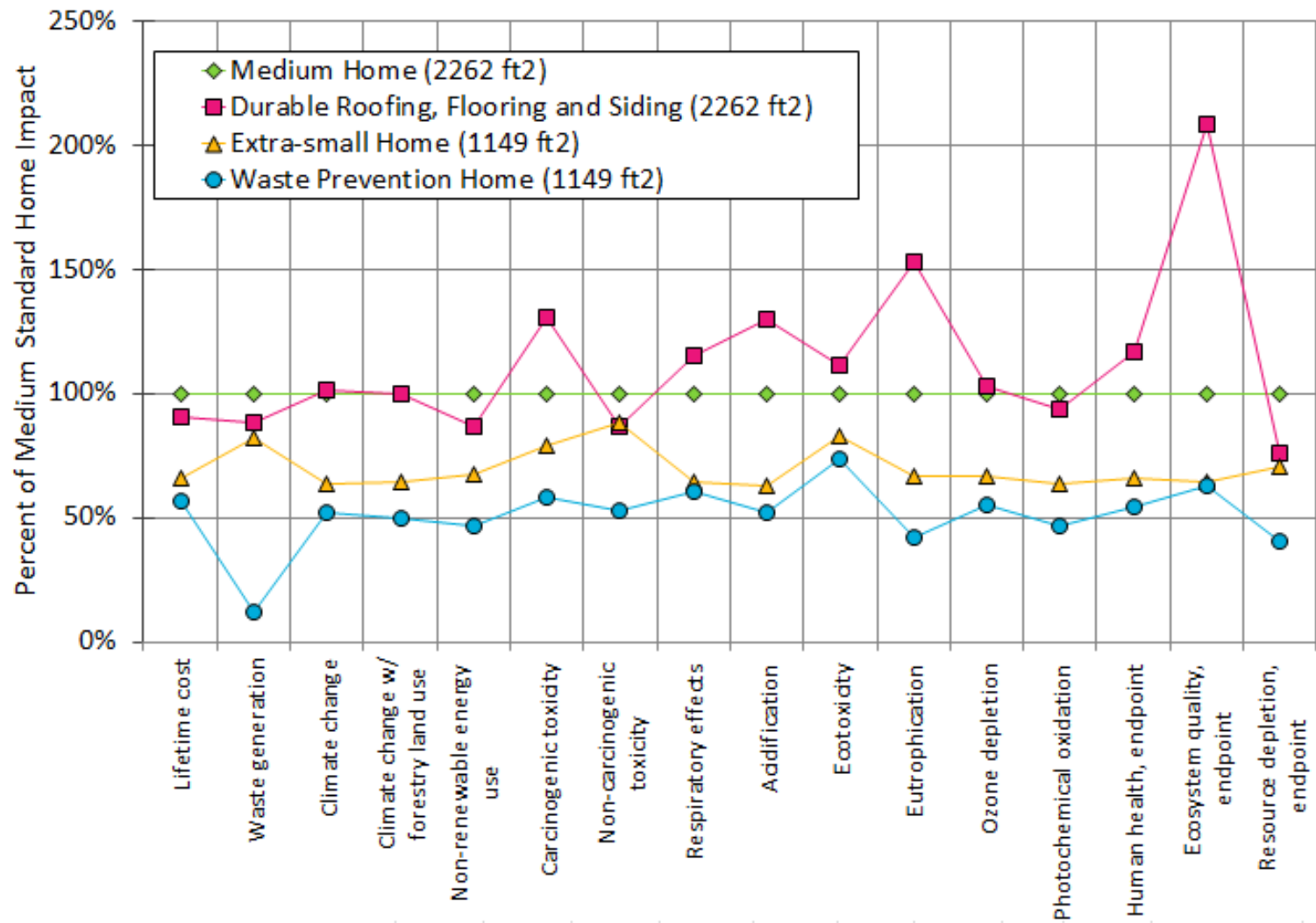


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Use of criteria like “durable” in material selection could mislead

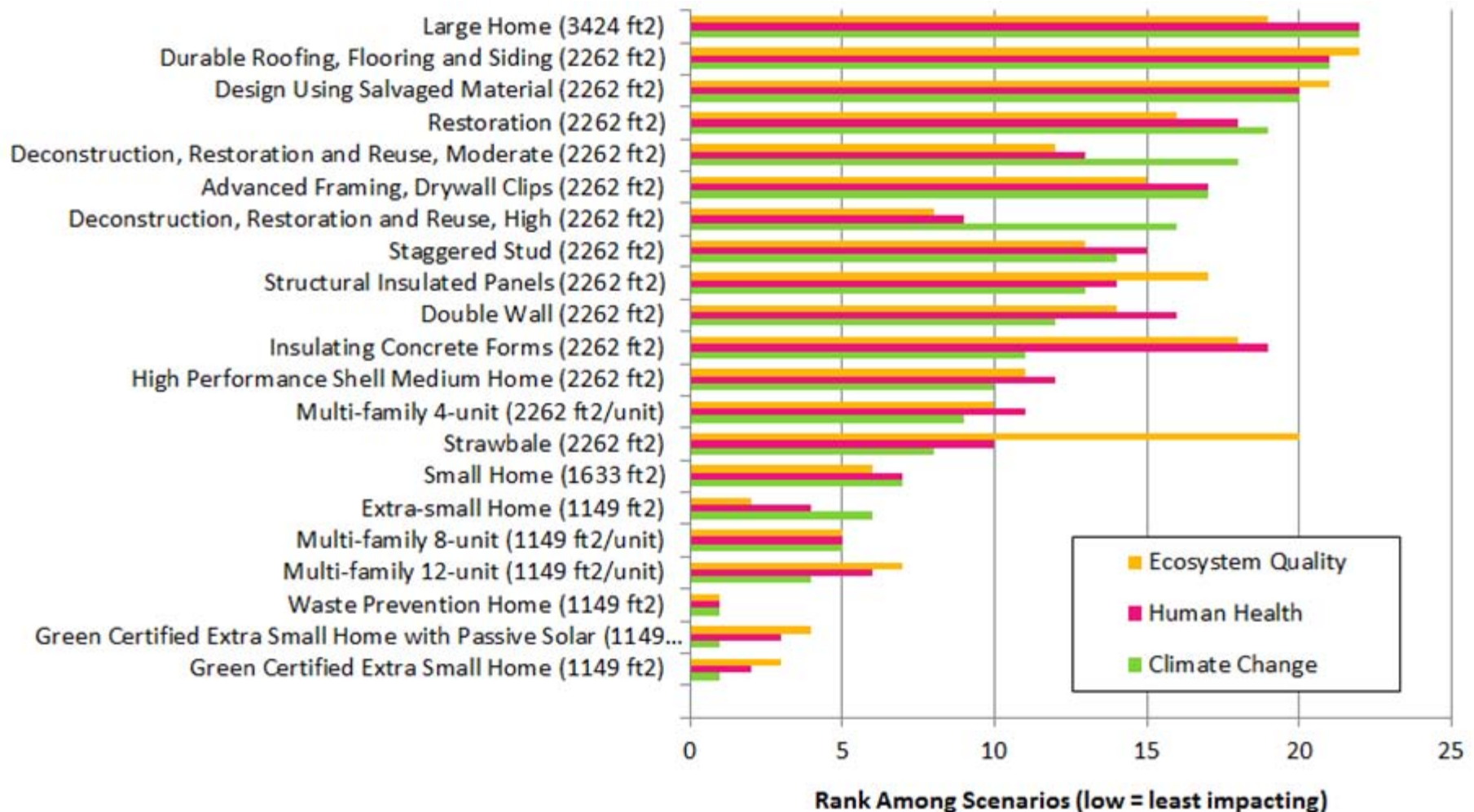
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Less than perfect correlation among impact categories

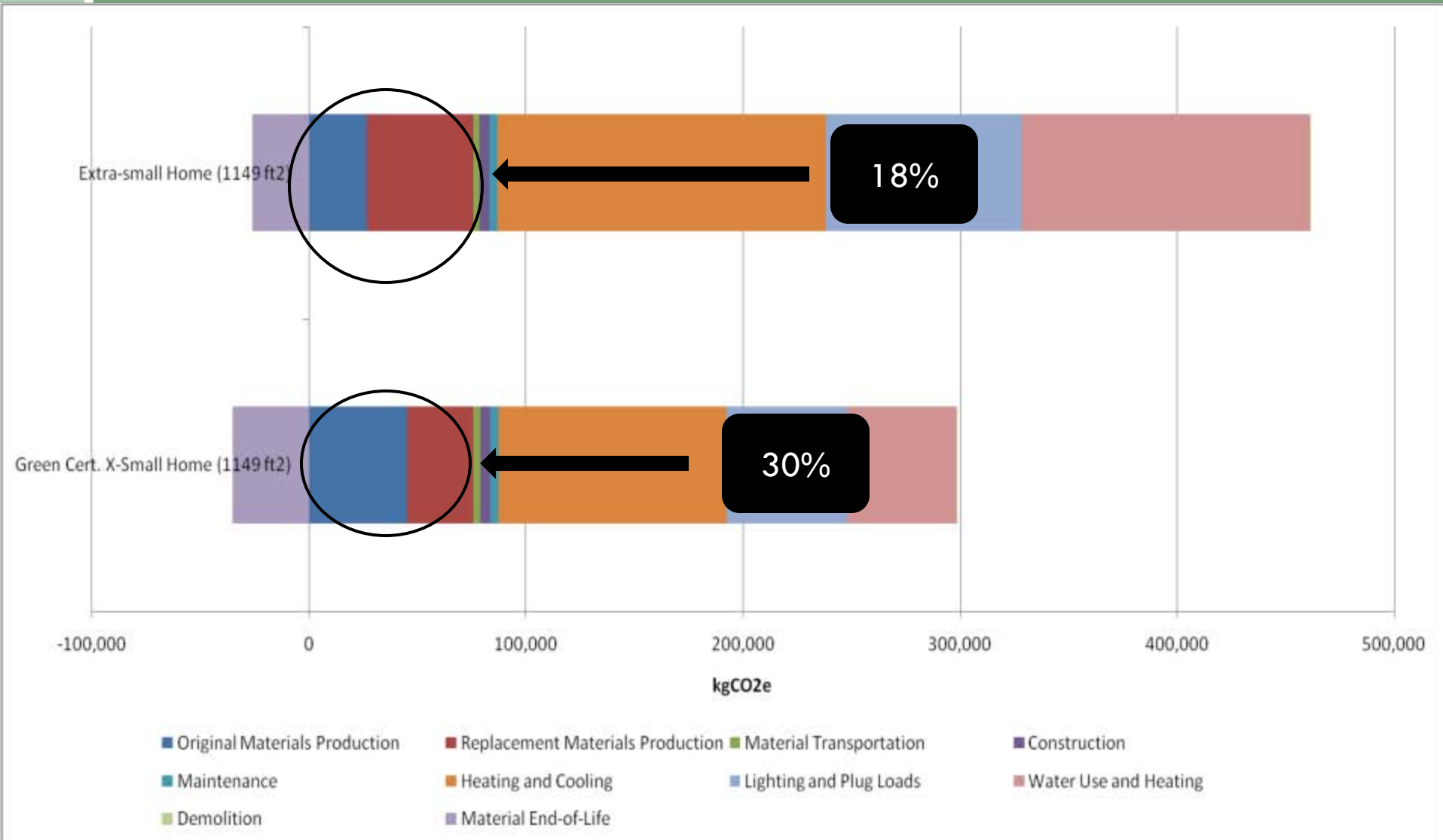


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Relative impact of materials change with energy efficiency

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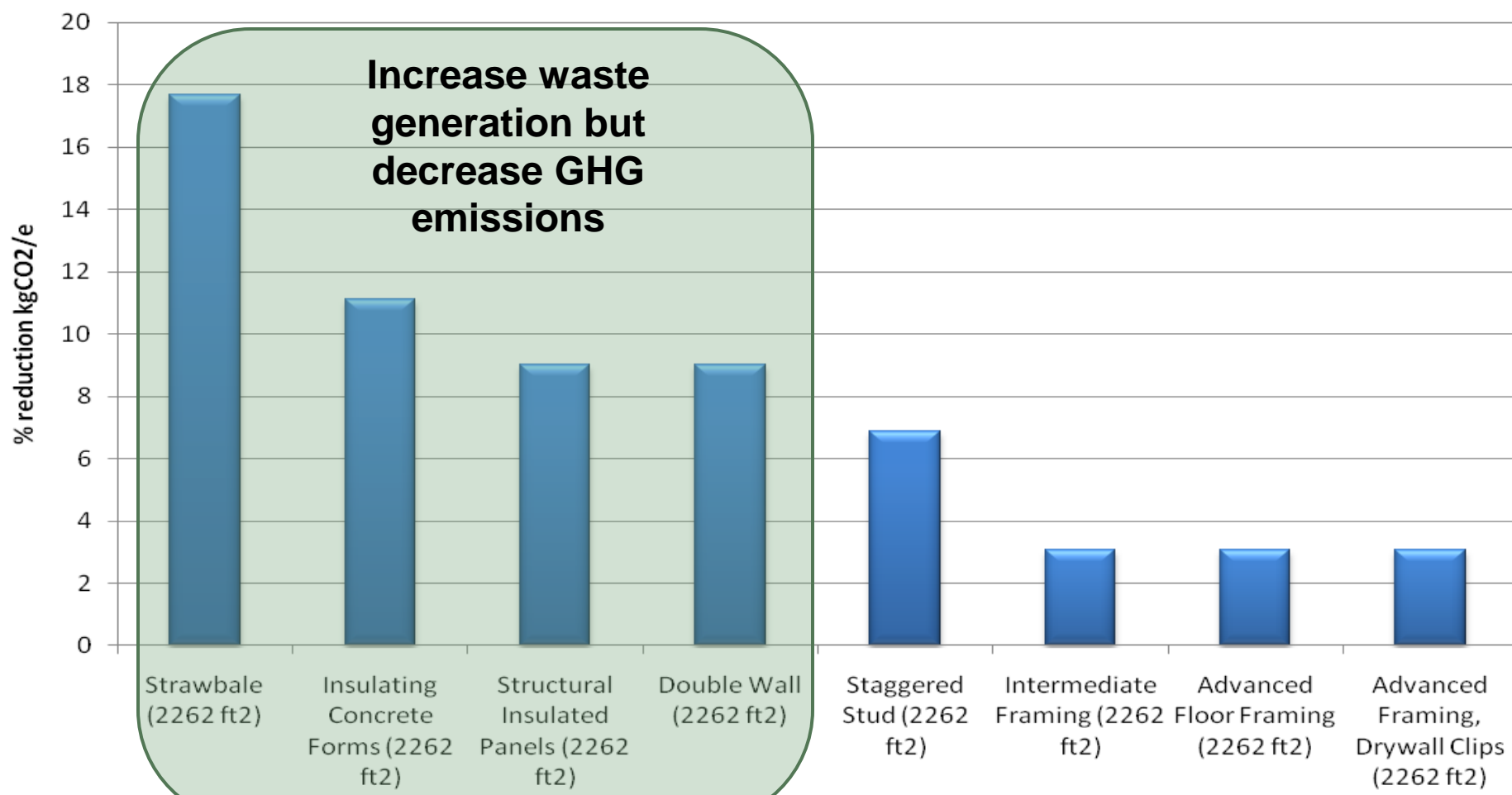


Wall framing shows that waste prevention is an incomplete goal



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% GHG reduction compared to Standard Home



Questions?

Discussion

Durable Materials



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□ Evaluated

- Asphalt vs. Metal roof
- Fiber cement vs. Cedar
- Carpet vs. Wood floor



□ Appropriate durability

- Granite?
- COR-TEN panels?

Salvage and Reuse

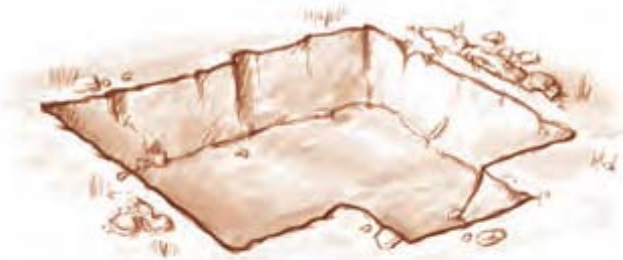
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- ❑ Prevents the most waste of any practice
- ❑ Don't reuse if energy efficiency is sacrificed
- ❑ Reuse reduces human health and ecosystem quality impacts more than climate change and energy use
- ❑ Short lived products are ripe for reuse
- ❑ Feature reuse – make it sexy
- ❑ It can be affordable – but beware of labor costs
- ❑ Keep it local
- ❑ High reuse environmental benefits for wood, metals, insulation, and plastics



Design for Adaptability

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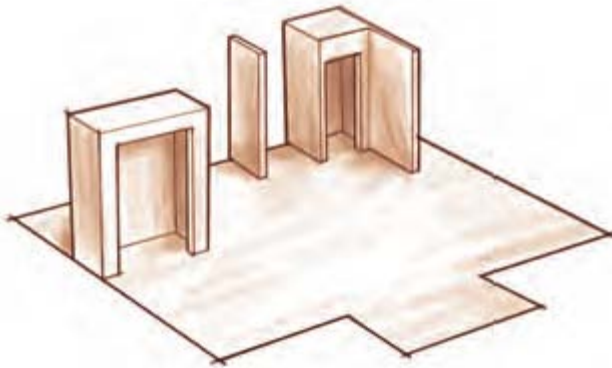
Site: Geological, timeless



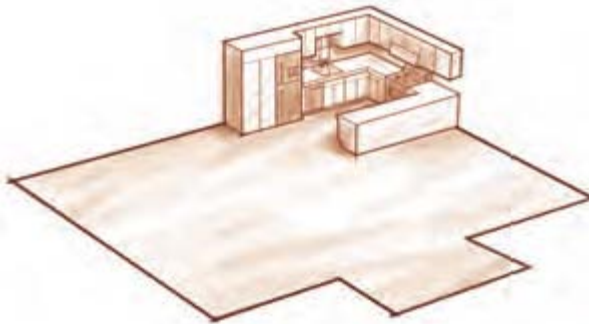
Structure: Lasts 100 to 300 years



Skin: 40- to 100-year life span



Space plan: Lasts 10 to 30 years



Services: Updated every 1 to 10 years



Stuff: Can change monthly

Bensonwood Homes Open-Built System

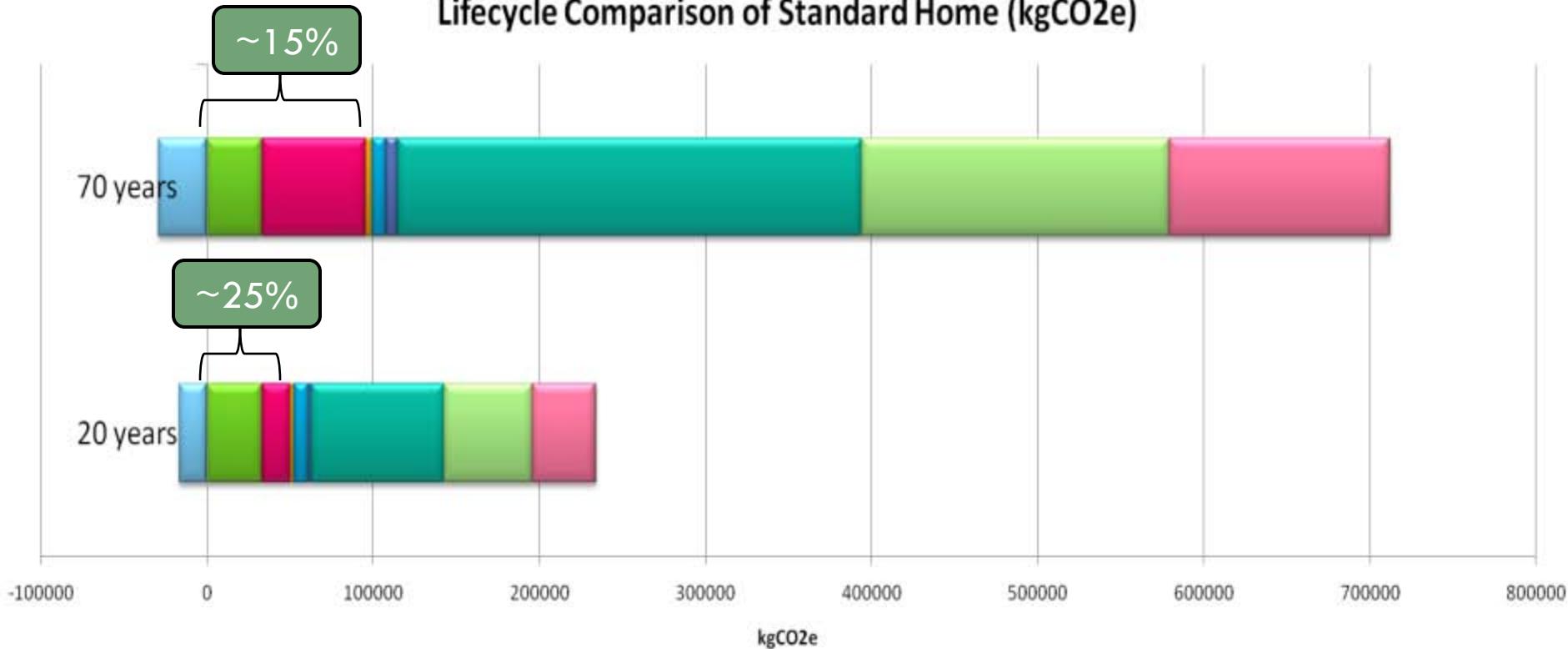
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Short/Long term GHG Mitigation

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Lifecycle Comparison of Standard Home (kgCO₂e)



Original Materials Production

Replacement Materials Production

Material Transportation

Construction

Maintenance

Heating and Cooling

Lighting and Plug Loads

Water Use, Heating, Treatment

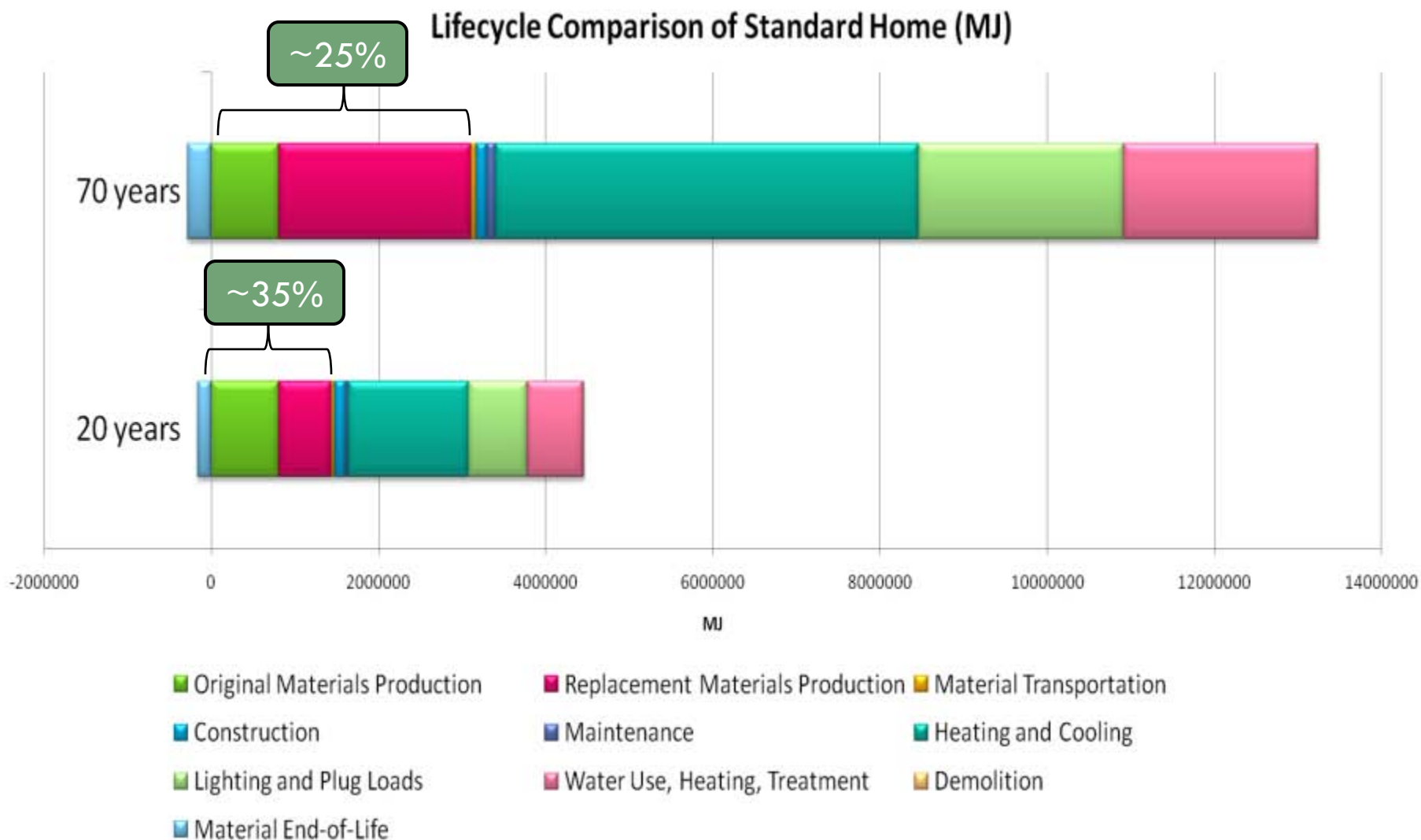
Demolition

Material End-of-Life

Short/Long term Energy Reductions



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Reducing material related impacts



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GOAL: Reduce the embodied carbon of building products by 50% by 2030

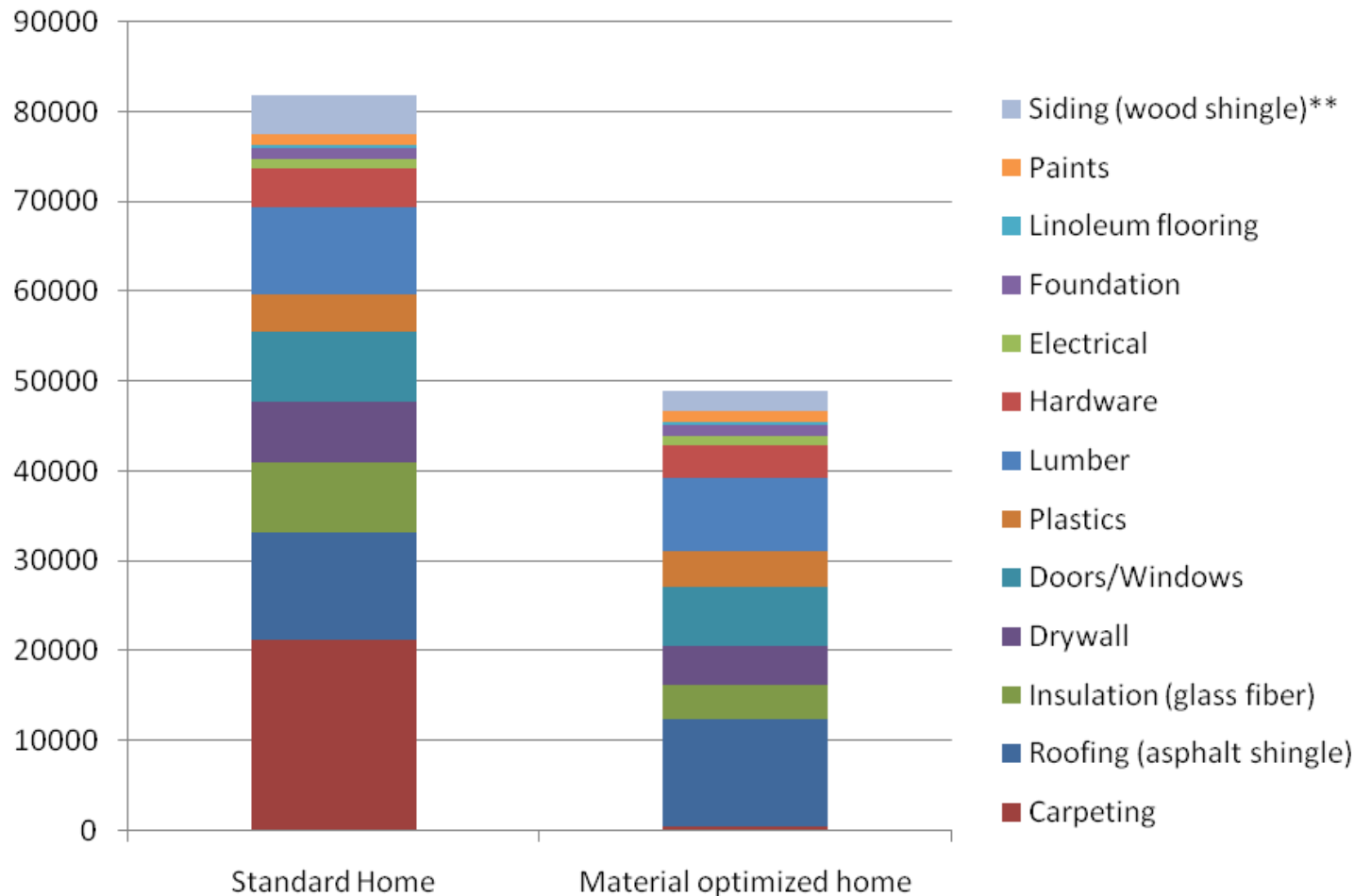
Architects/Specifiers: Ask for Environmental Product Declarations (Eco-labels based on material specific Product Category Rules)

Example – Reducing embodied carbon of building products



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Example - How to reduce material impacts



35% reduction achieved by:

- Using wood floors instead of carpet
- Reducing drywall by half and using wood wainscoting
- 25% less remodeling or water damage to framing and hardware
- 50% reduction in siding due to better maintenance

Limitations – occupant exposure and indoor air quality

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Health Concerns

Spray polyurethane foam (SPF) is a highly-effective and widely used insulation and air sealant material. However, exposures to its key ingredient, isocyanates, and other [SPF chemicals](#) in vapors, aerosols, and dust during and after installation can cause asthma, sensitization, lung damage, other respiratory and breathing problems, and skin and eye irritation.

- [Health Concerns Associated with Side A: Isocyanates](#)
- [Health Concerns Associated with Side B: Polyol Blend](#)

Health Concerns Associated with Side A: Isocyanates

Isocyanates are a class of highly reactive chemicals with widespread industrial, commercial, and retail or consumer applications.

Exposure to isocyanates may cause skin, eye and lung irritation, asthma, and "sensitization." Isocyanates have been reported to be the leading attributable chemical cause of work-related asthma. Both dermal and respiratory exposures

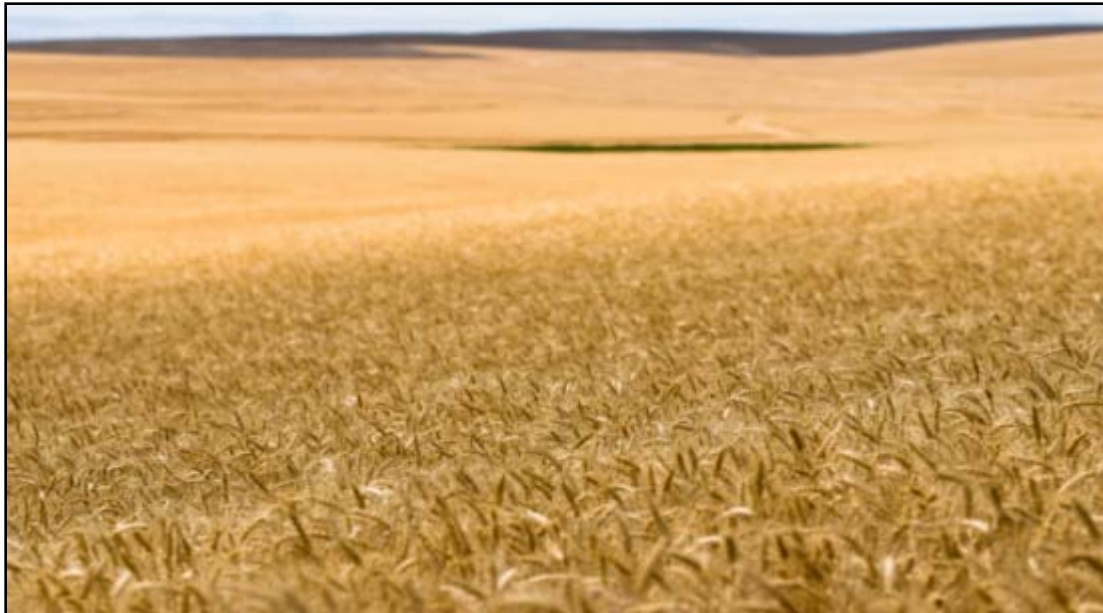
Spray Polyurethane Foam (SPF) Site Navigation

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- [Quick Safety Tips for SPF Users](#)
- [SPF Chemicals](#)
- [Types of SPF Products](#)
- [Exposure Potential](#)
- [Health Concerns](#)
- [Steps to Control Exposure](#)
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- [Related Federal Activities](#)
- [Related International Activities](#)

Material Substitution Ideas

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- Drywall – clay plaster, clay panels, wood paneling
- Floors – hardwood, earthen
- Roofing – let's discuss....
- Insulation – cellulose, straw clay, clay chip, strawbale



Thank You!



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Department of
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