



ENERGY CENTER  
OF WISCONSIN

# Minnesota Multifamily Rental Characterization Study

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February 25, 2014

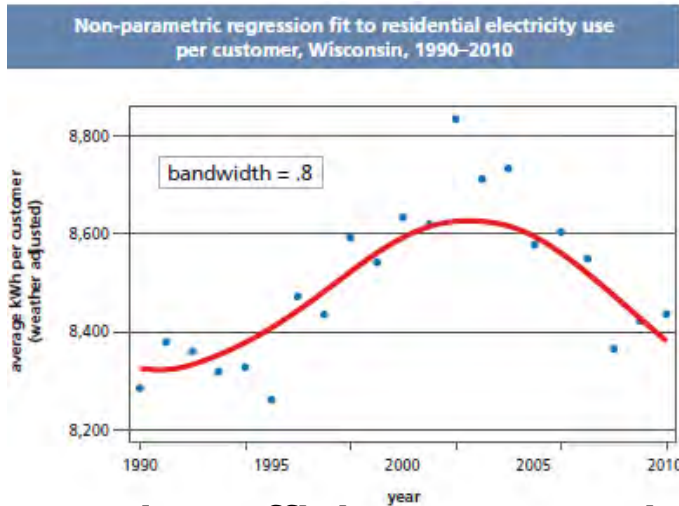
Duluth Energy Design Conference

In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

“This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors** continuing education requirements.”

For additional continuing education approvals, please see your credit tracking card.

RESEARCH



conduct efficiency research



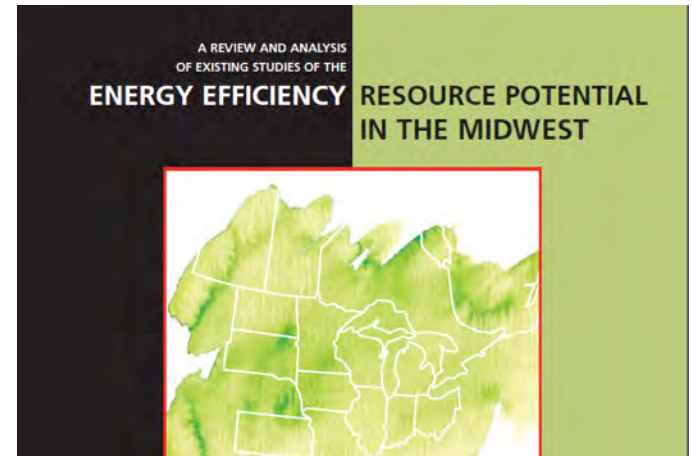
educate energy professionals

DESIGN ASSISTANCE



design efficient buildings

POLICY ANALYSIS



prepare policy analyses



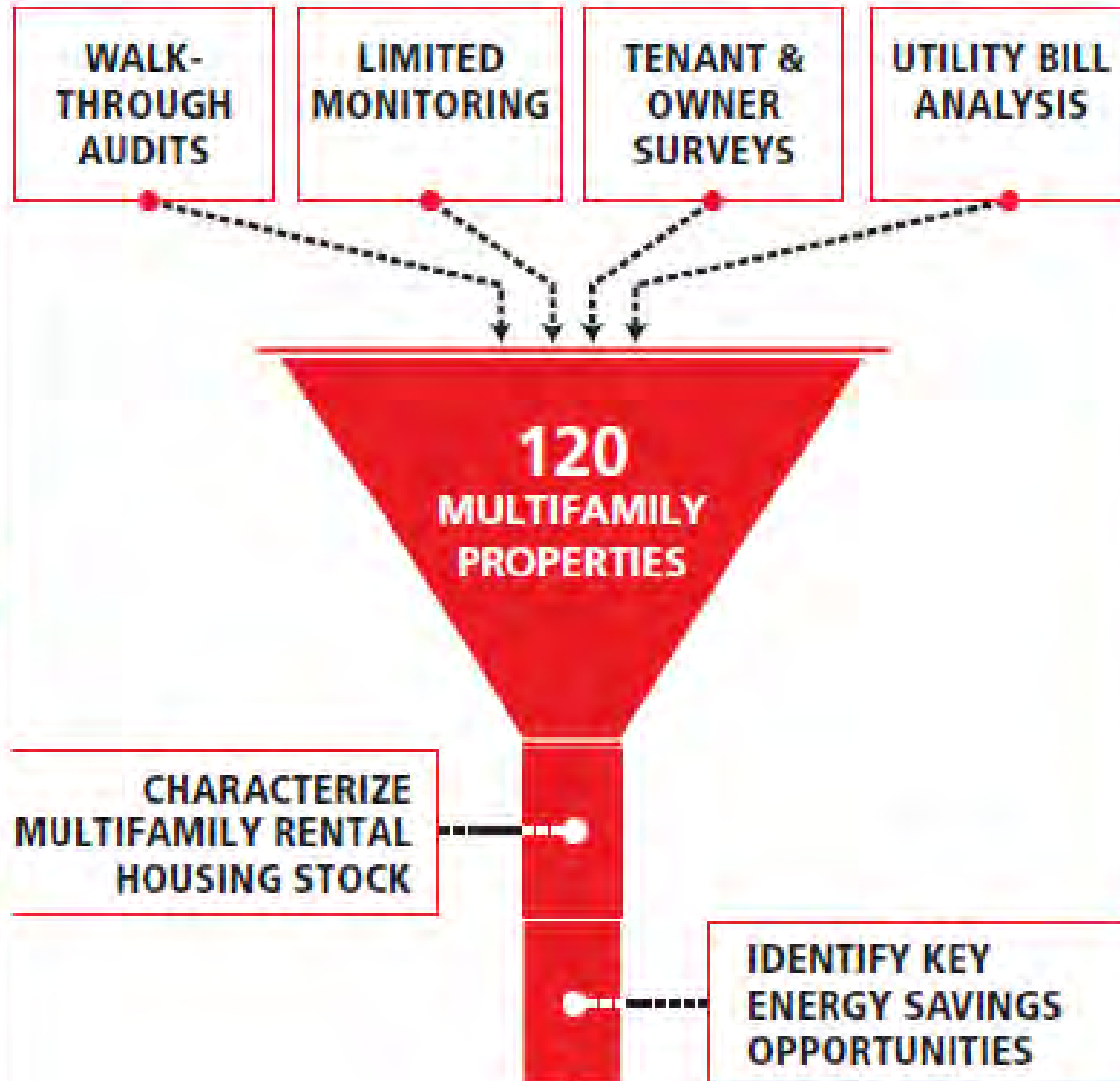
**Conservation Applied Research  
& Development (CARD) Program**

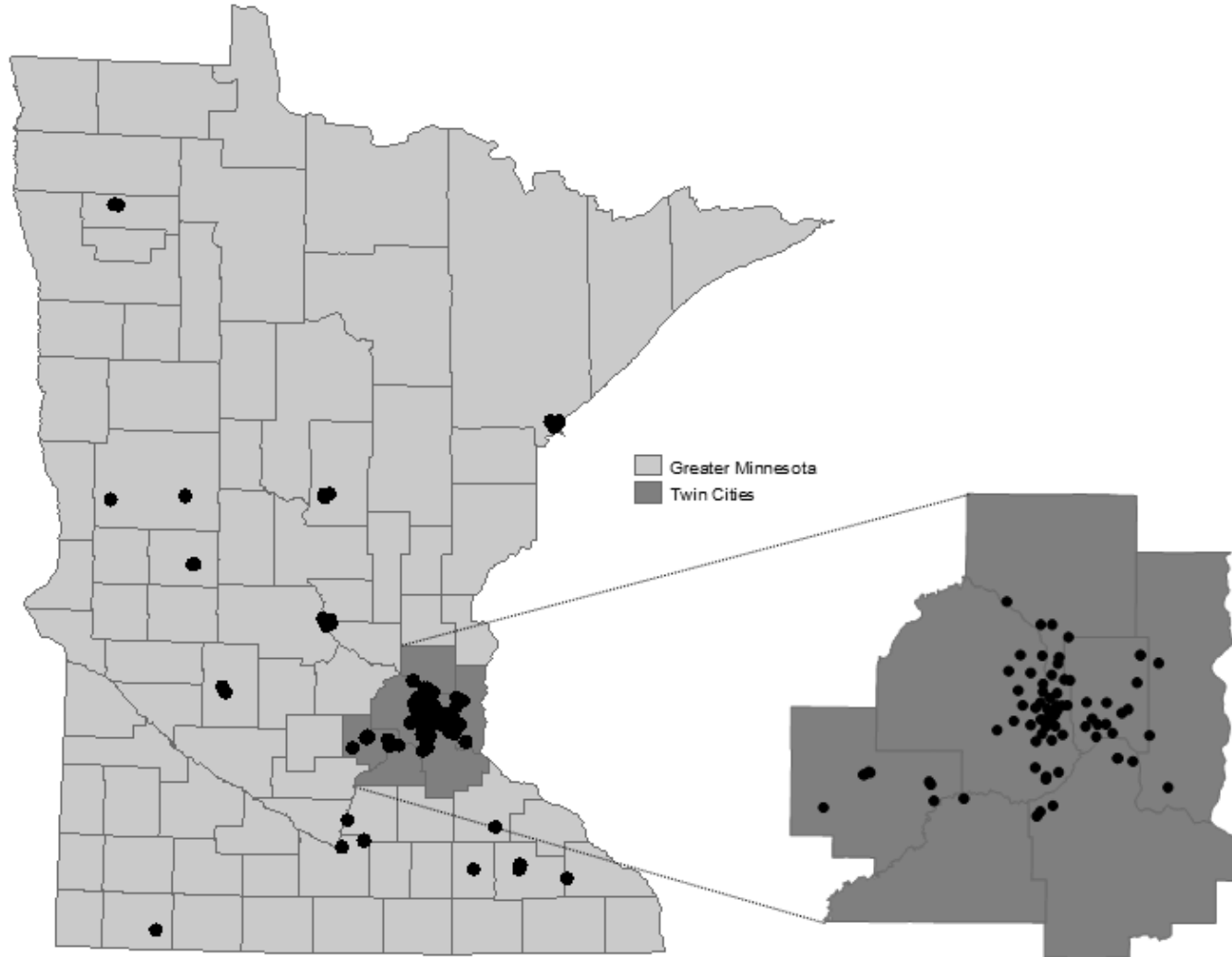
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- **Characterize** the MN MF building stock
- **Benchmark** energy use
- Assess **efficiency opportunities**
- Explore **attitudes and behavior** of tenants and owners/managers







MINNESOTA RENTAL HOUSING ENERGY USE STUDY

Your opinion is valuable

We'll give you **CASH** if you go online and tell us about energy use in your apartment.





# 5 to 9 unit buildings



# 10 to 19 unit buildings



## 20 to 49 unit buildings



## 50+ unit buildings



# PRE-WORLD WAR II

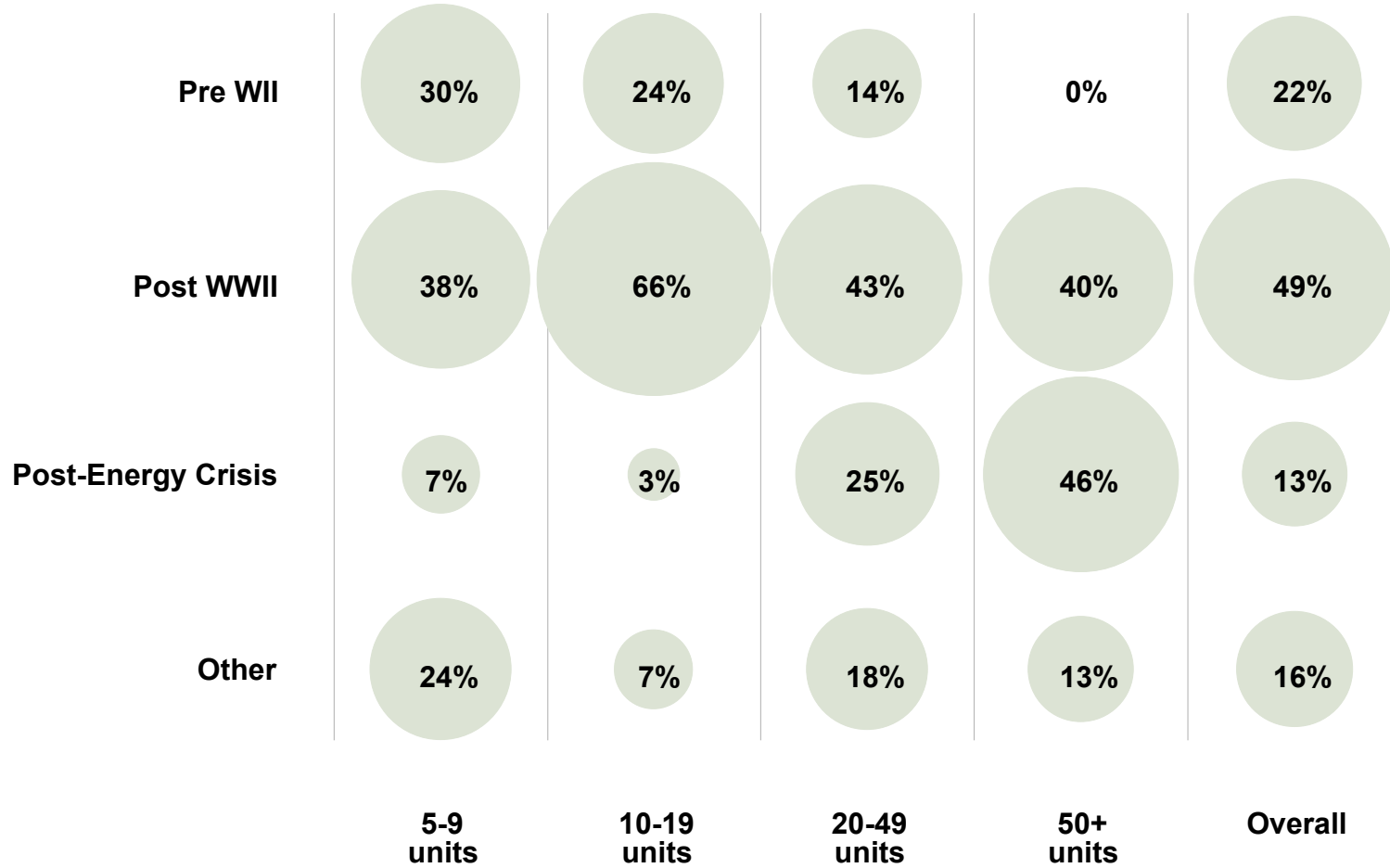


# POST-WORLD WAR II



# POST ENERGY CRISIS



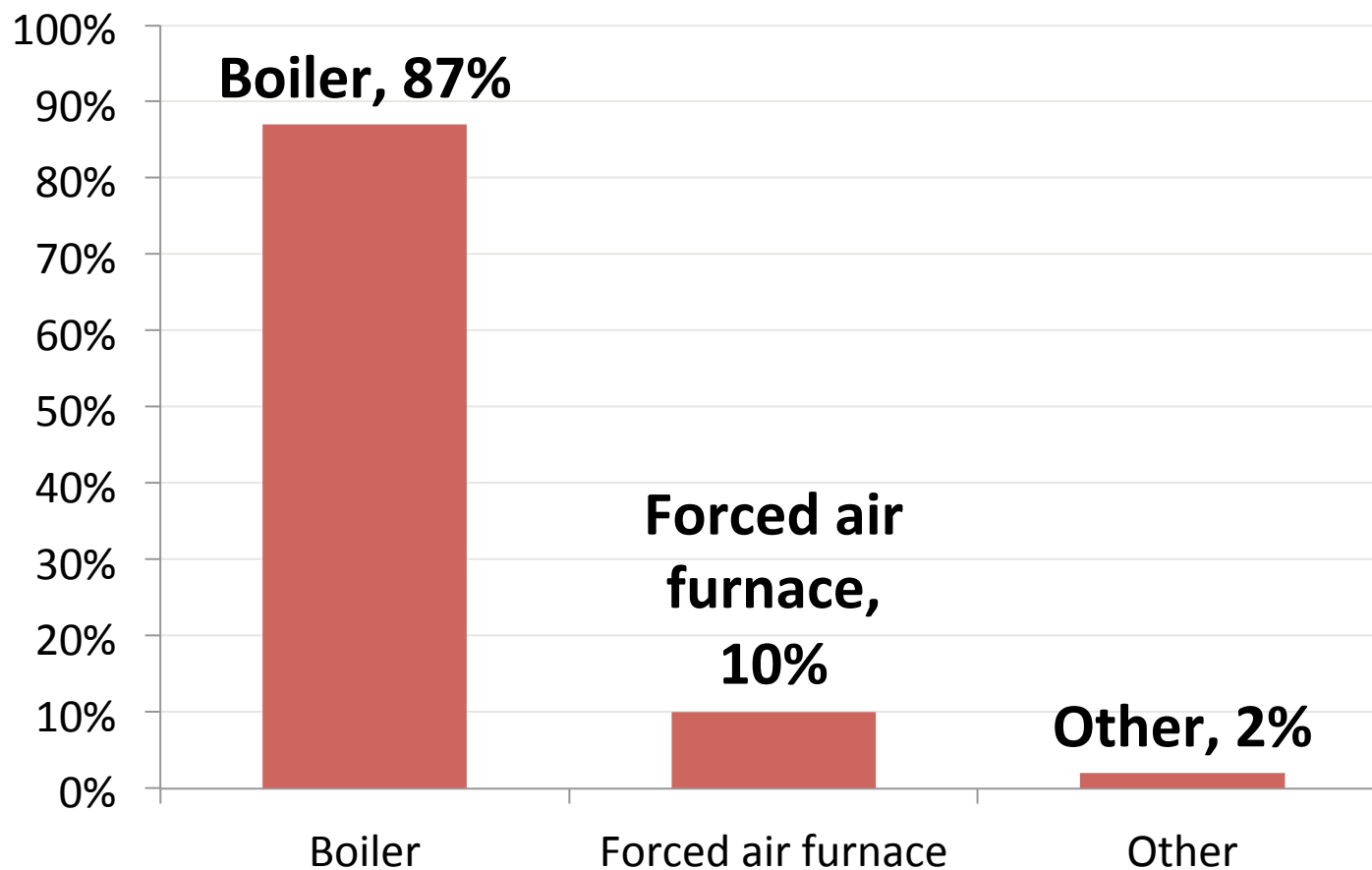


Columns sum to 100%  
 Area of shaded circles are proportional to column percent



**BUILDING  
CHARACTERISTICS**

## OVERALL TYPE



## Energy related features

EFFICIENCY CLASS

VENT DAMPERS

CONTROLS

DISTRIBUTION SYSTEM



## Energy related features

EFFICIENCY CLASS

VENT DAMPERS

CONTROLS

DISTRIBUTION SYSTEM



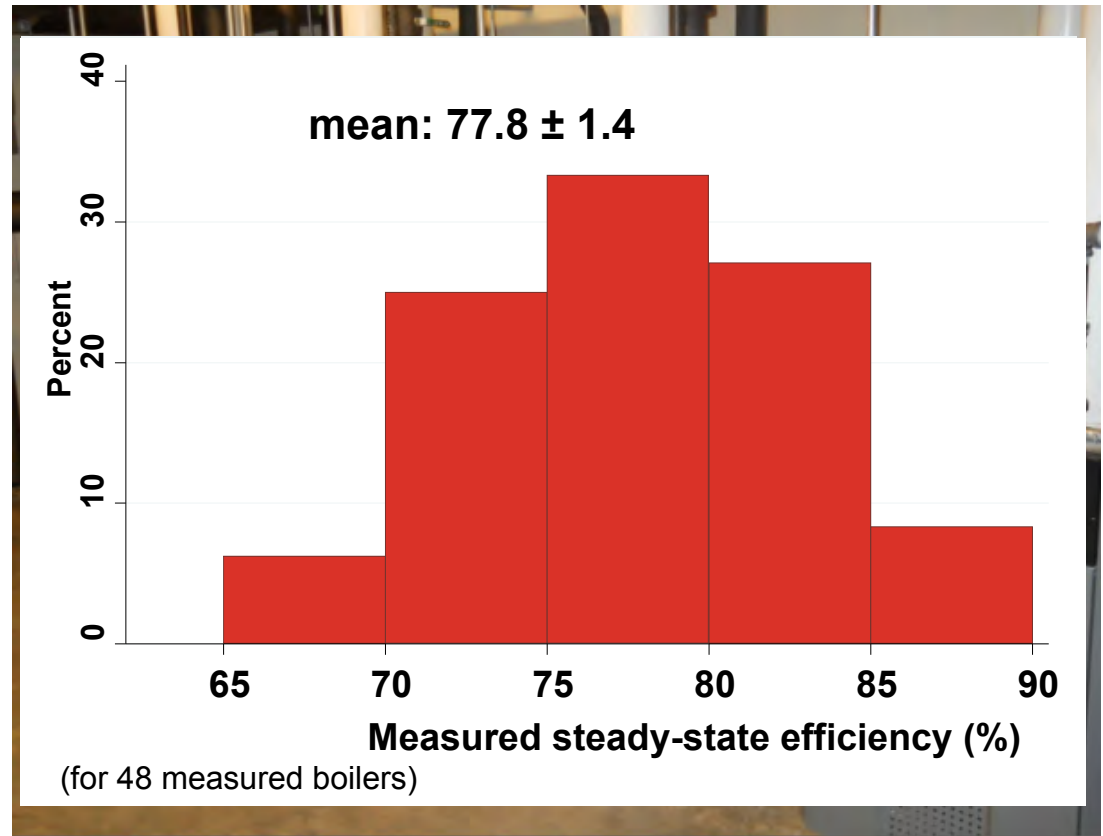
## Energy related features

EFFICIENCY CLASS

VENT DAMPERS

CONTROLS

DISTRIBUTION SYSTEM



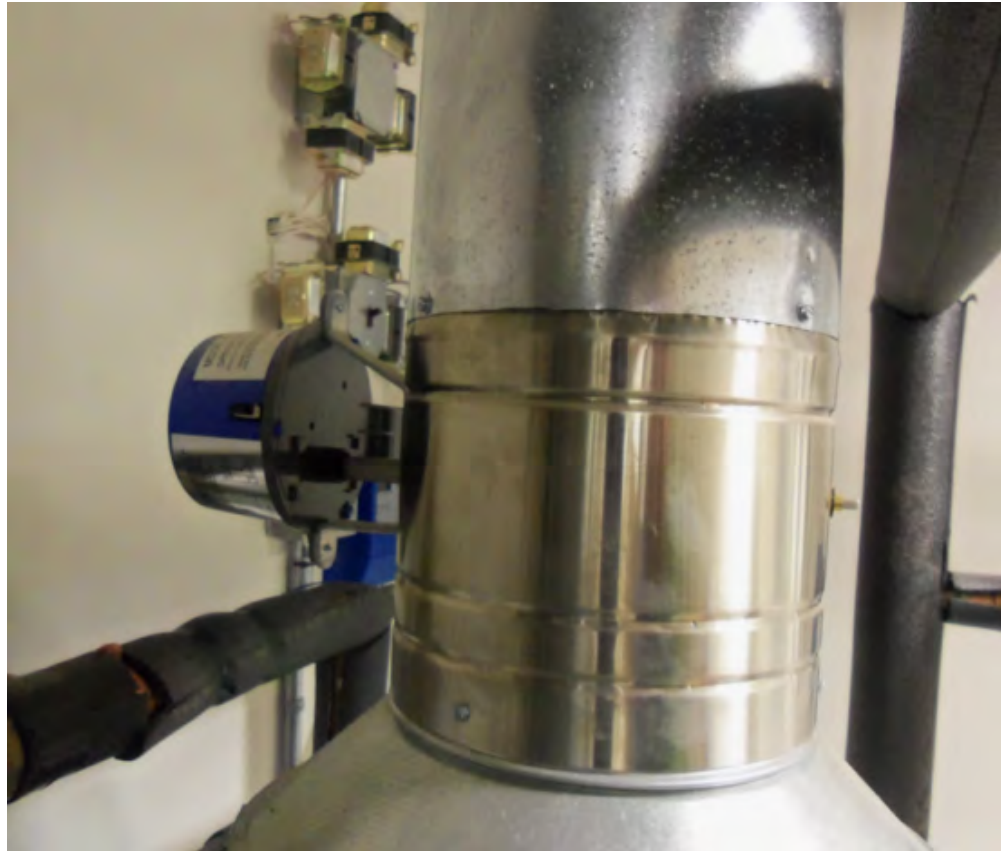
## Energy related features

EFFICIENCY CLASS

VENT DAMPERS

CONTROLS

DISTRIBUTION SYSTEM



## Energy related features

EFFICIENCY CLASS

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## Energy related features

EFFICIENCY CLASS

VENT DAMPERS

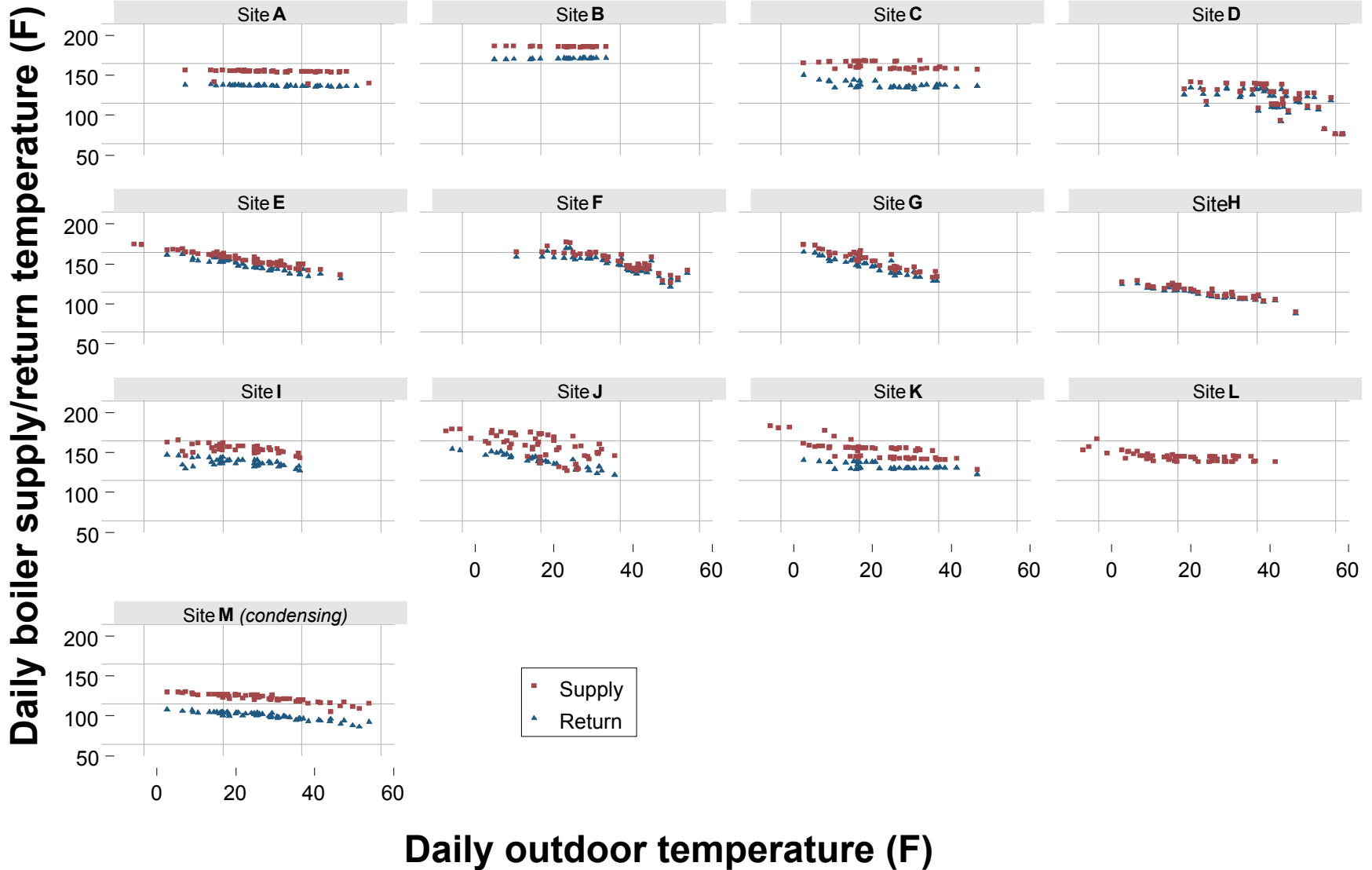
CONTROLS

DISTRIBUTION SYSTEM





# Supply – return measurements



## Common types of A/C units

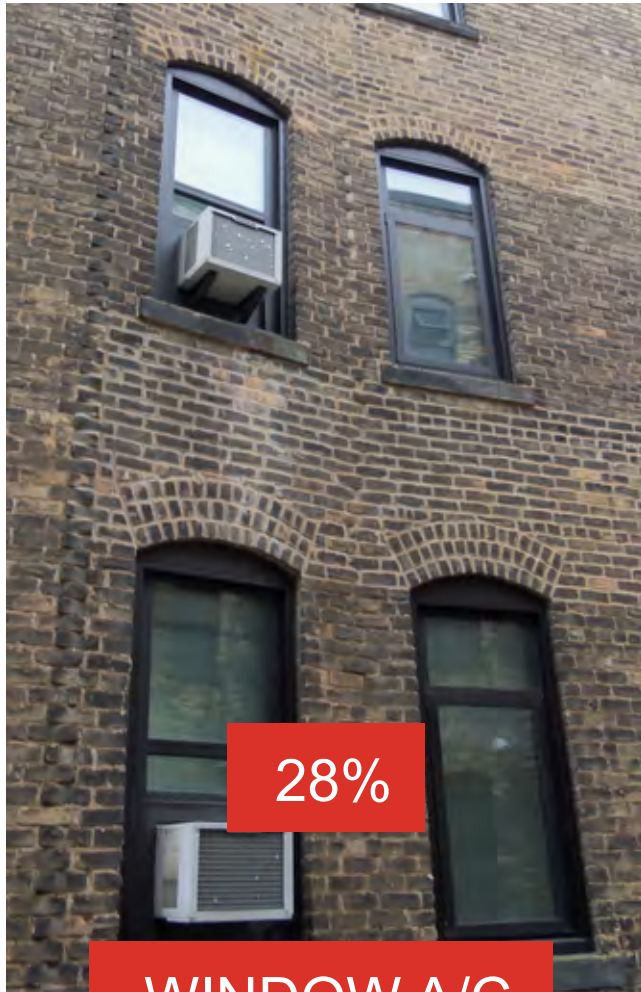


WINDOW A/C



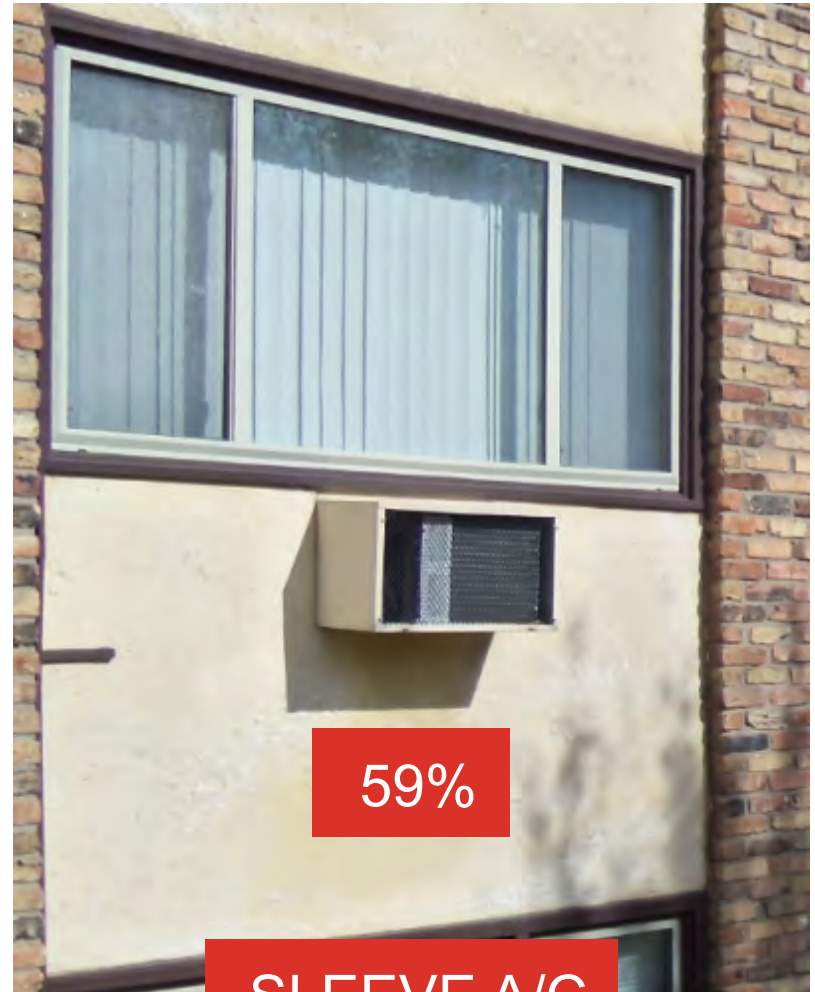
SLEEVE A/C

## Common types of A/C units



28%

WINDOW A/C



59%

SLEEVE A/C

## Common types of A/C units



Provided by landlord: 76%  
Provided by tenant: 24%

28%

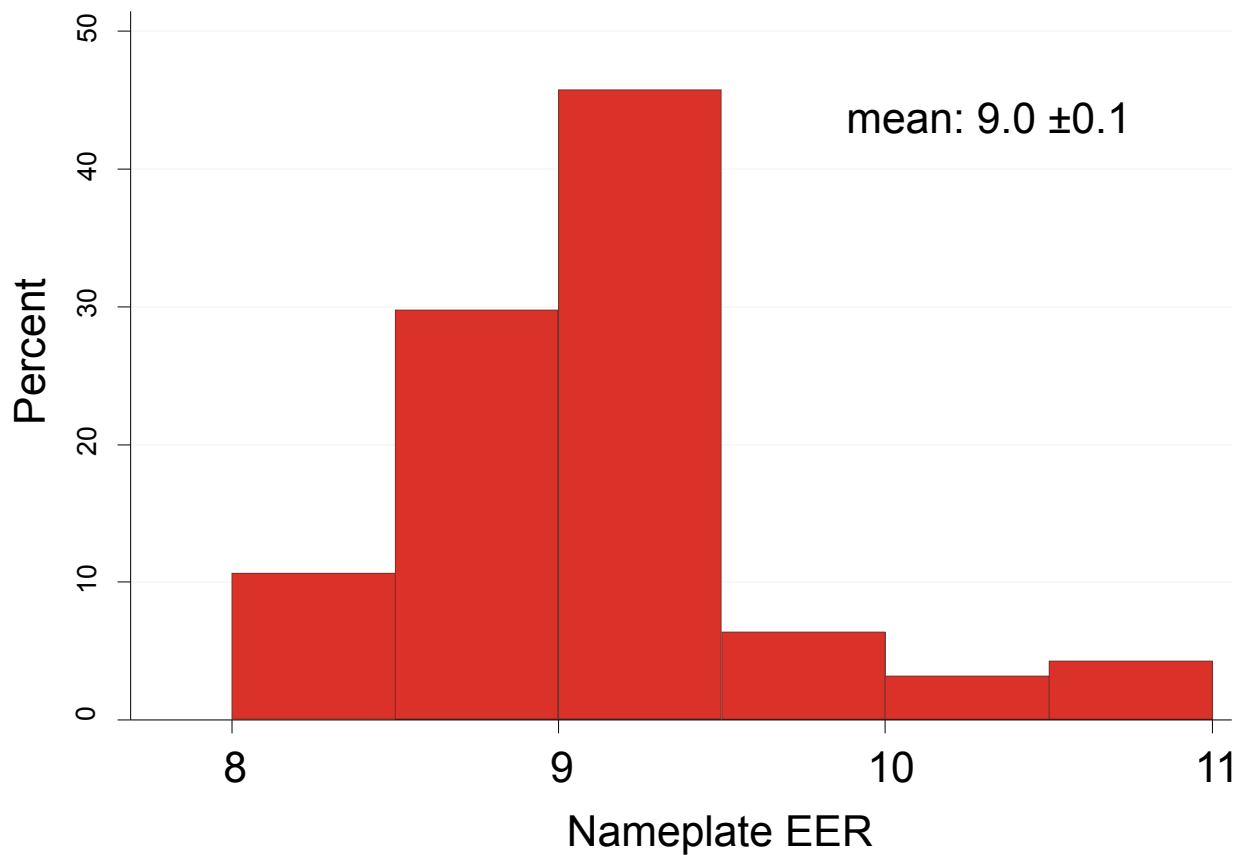
WINDOW A/C



59%

SLEEVE A/C

## Nameplate capacity



For 94 units with nameplate information.

## Common types

Individual conventional tank

8%

Central conventional tank

68%

Indirect-fired with dedicated  
boiler

15%

Indirect fired with shared boiler

9%

## Common types

Individual conventional tank

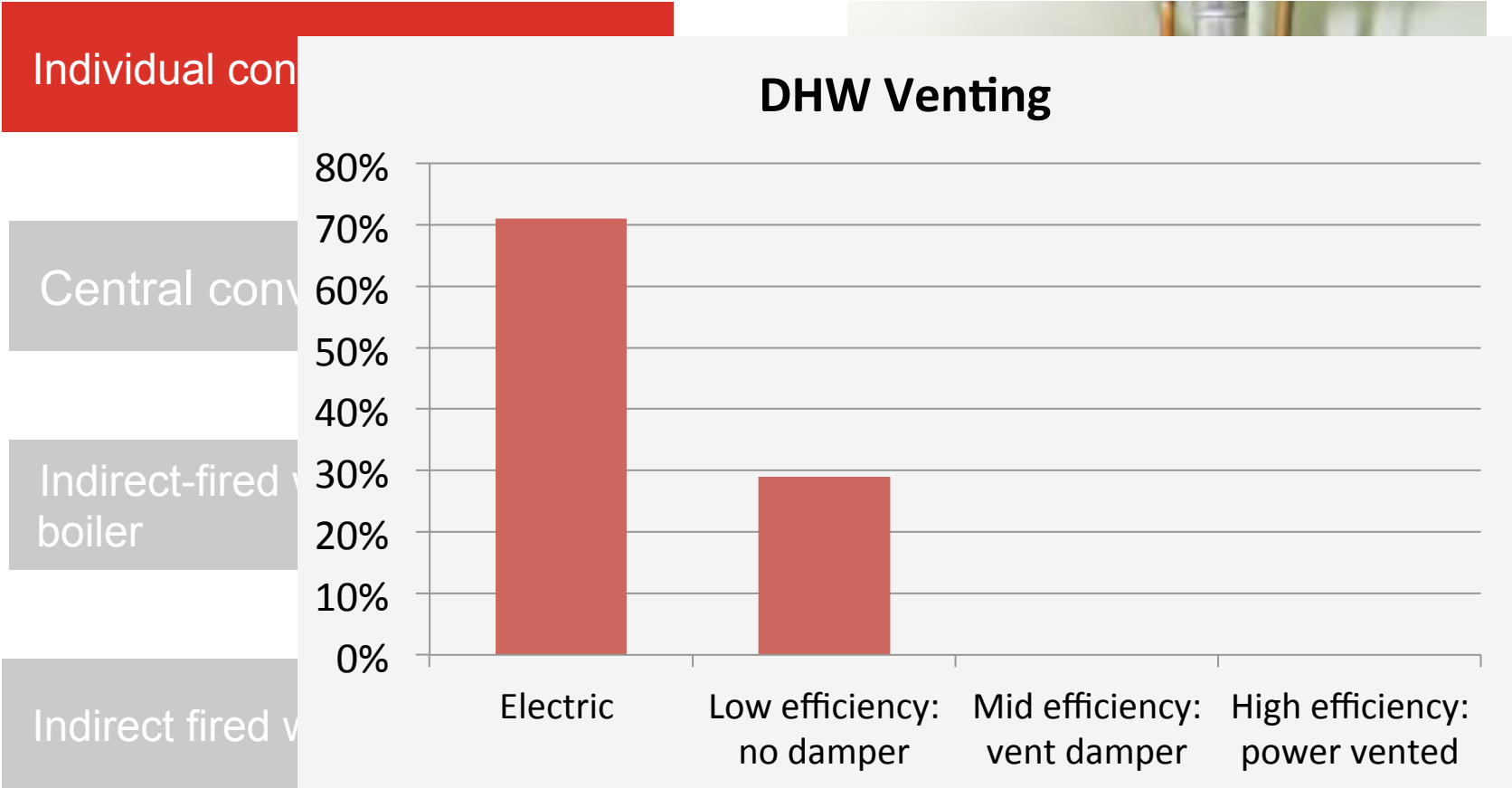
Central conventional tank

Indirect-fired with dedicated boiler

Indirect fired with shared boiler



# Common types

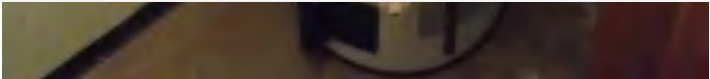


Individual con

Central conv

Indirect-fired v  
boiler

Indirect fired v





## Common types

Individual conventional tank

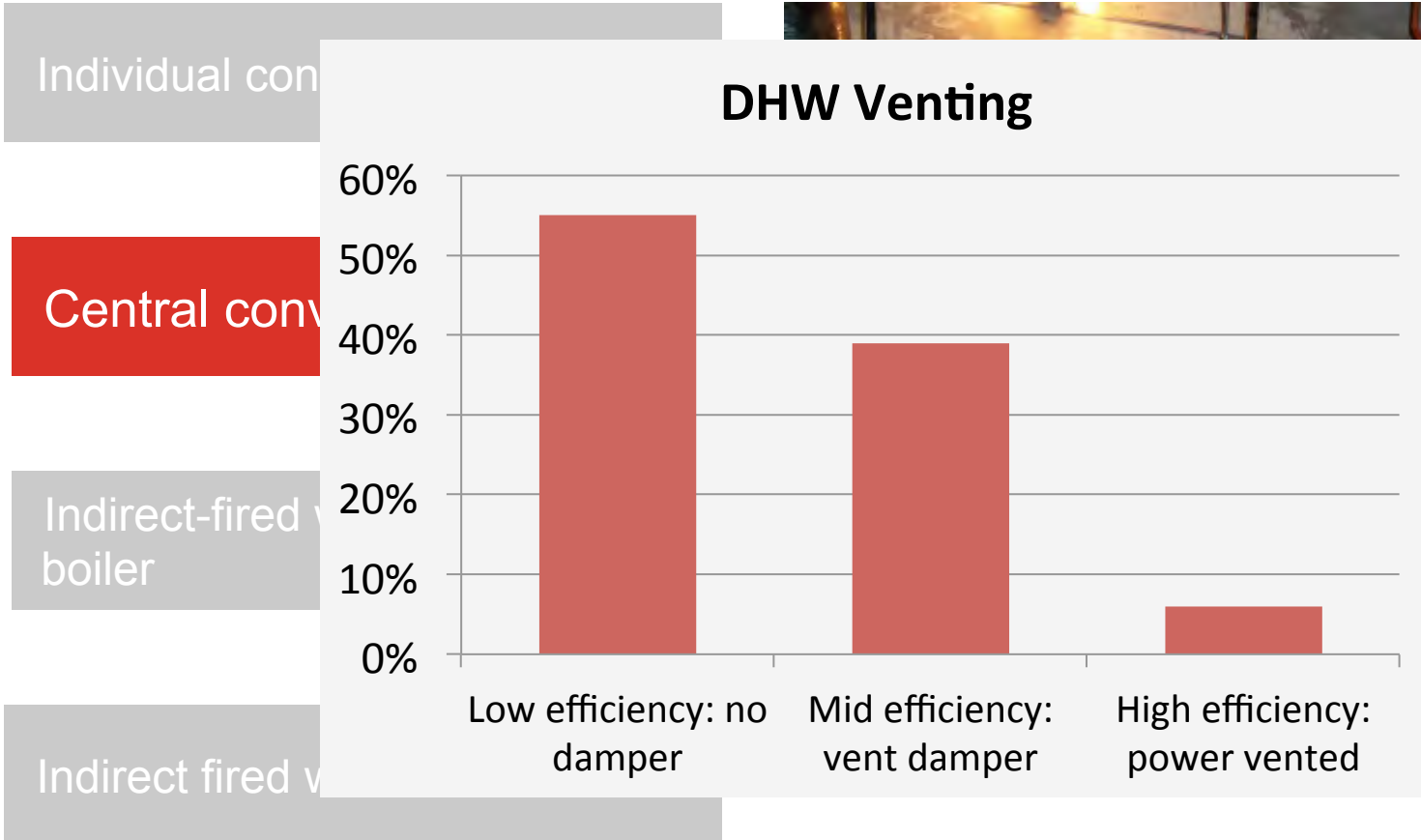
Central conventional tank

Indirect-fired with dedicated boiler

Indirect fired with shared boiler



# Common types



## Common types

Individual conventional tank

Central conventional tank

Indirect-fired with dedicated  
boiler

Indirect fired with shared boiler



## Common types

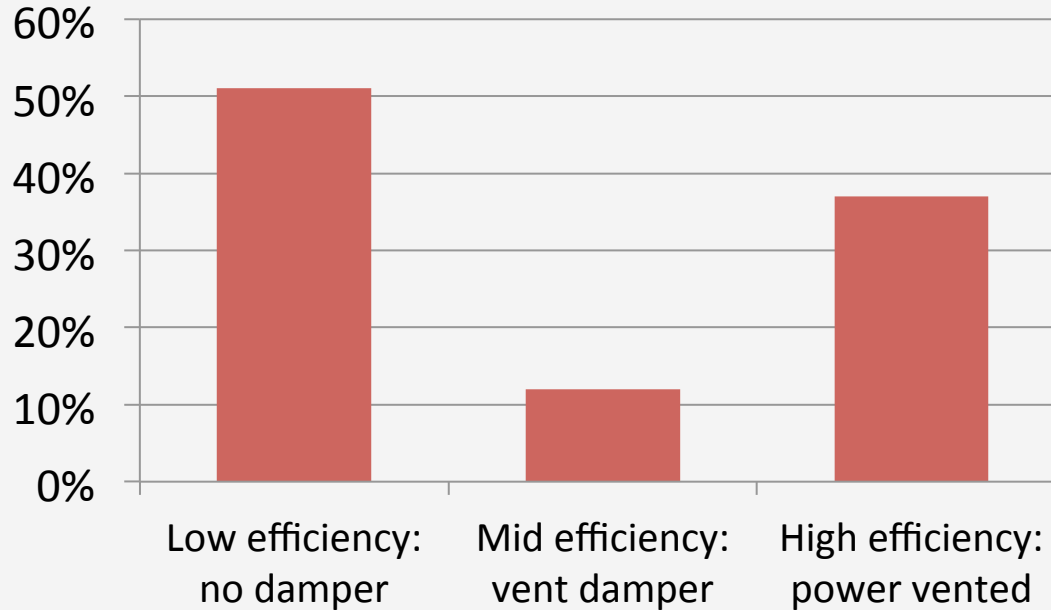
Individual

Central

Indirect-fired  
boiler

Indirect fired with shared boiler

### DHW Venting



## Common types

Individual conventional tank

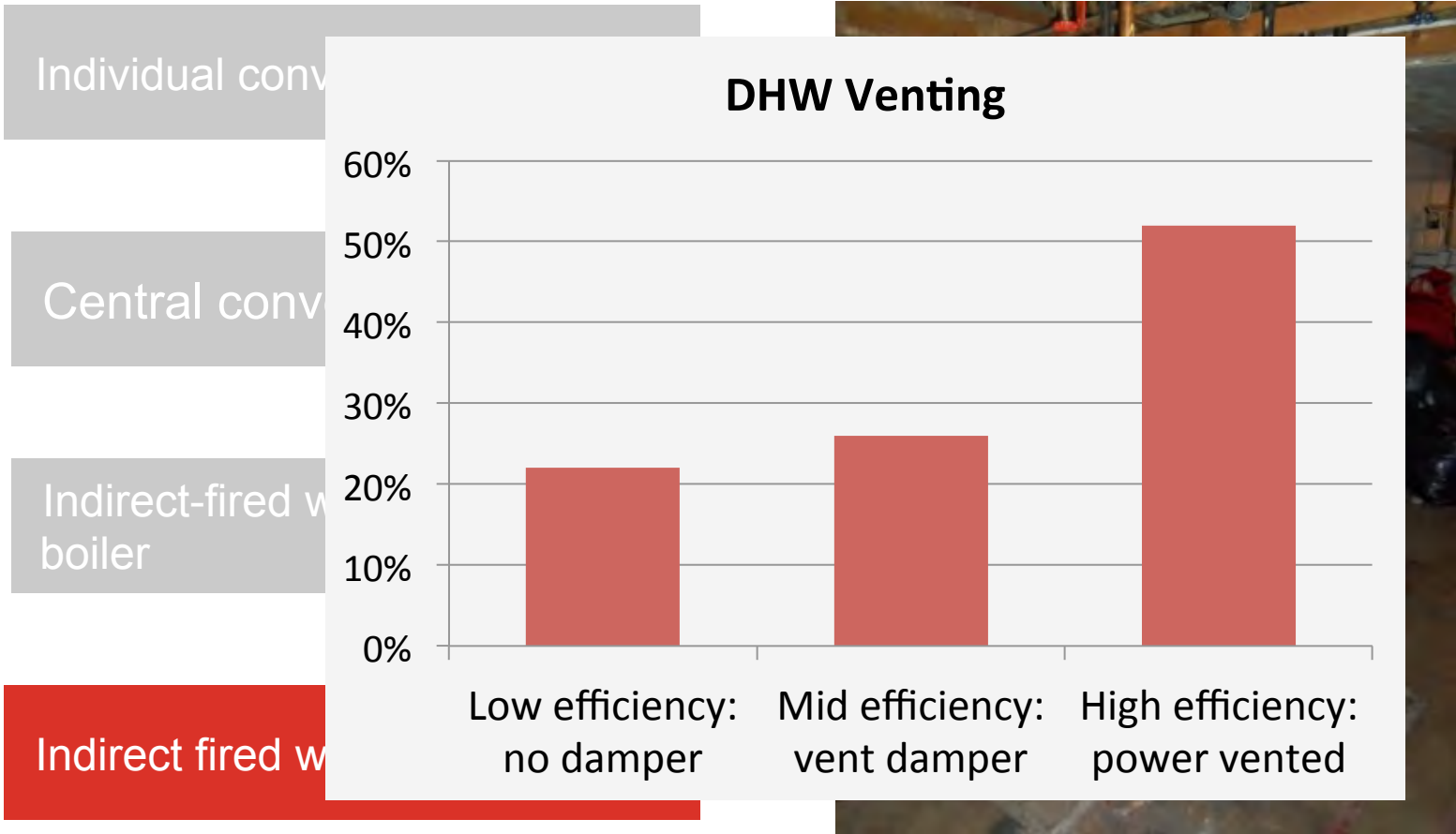
Central conventional tank

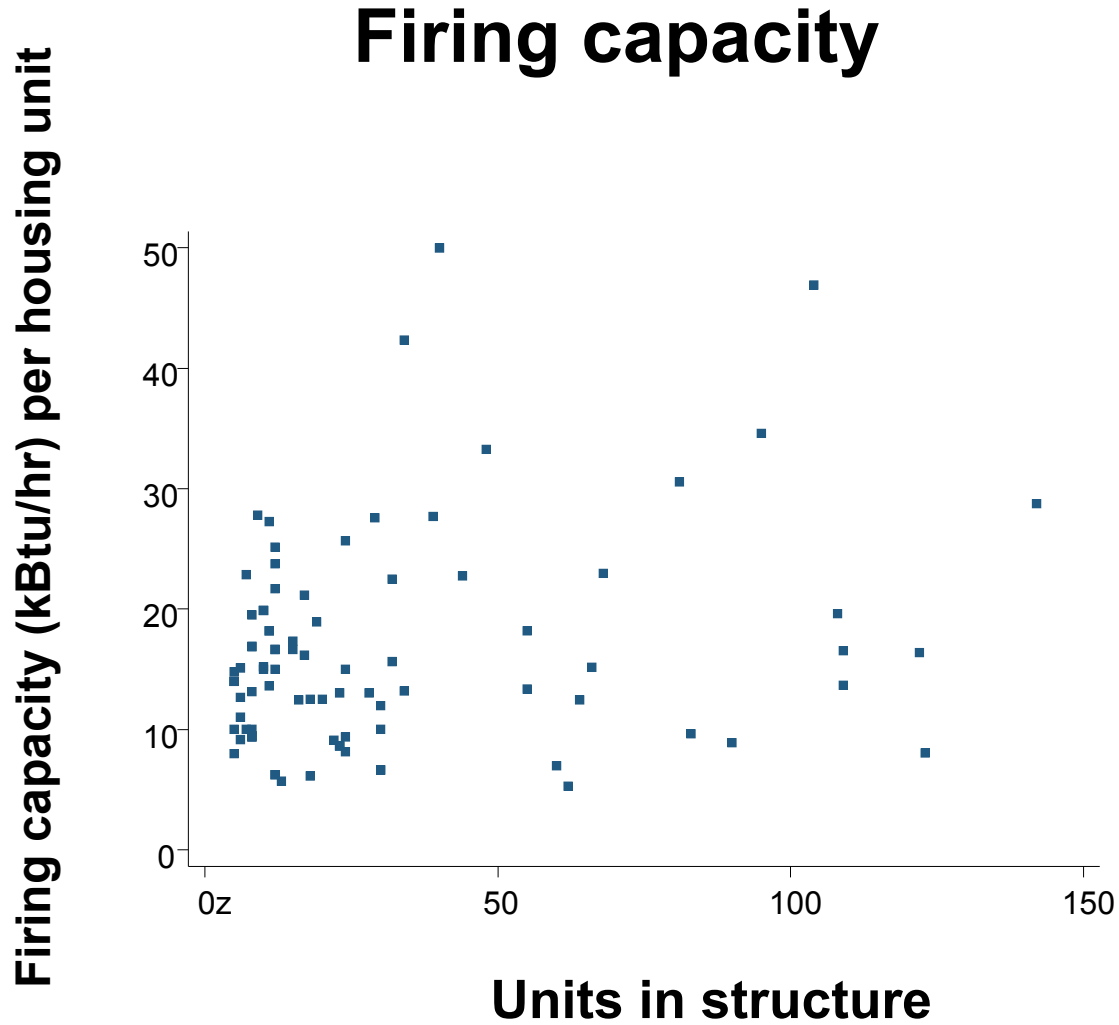
Indirect-fired with dedicated boiler

Indirect fired with shared boiler



# Common types



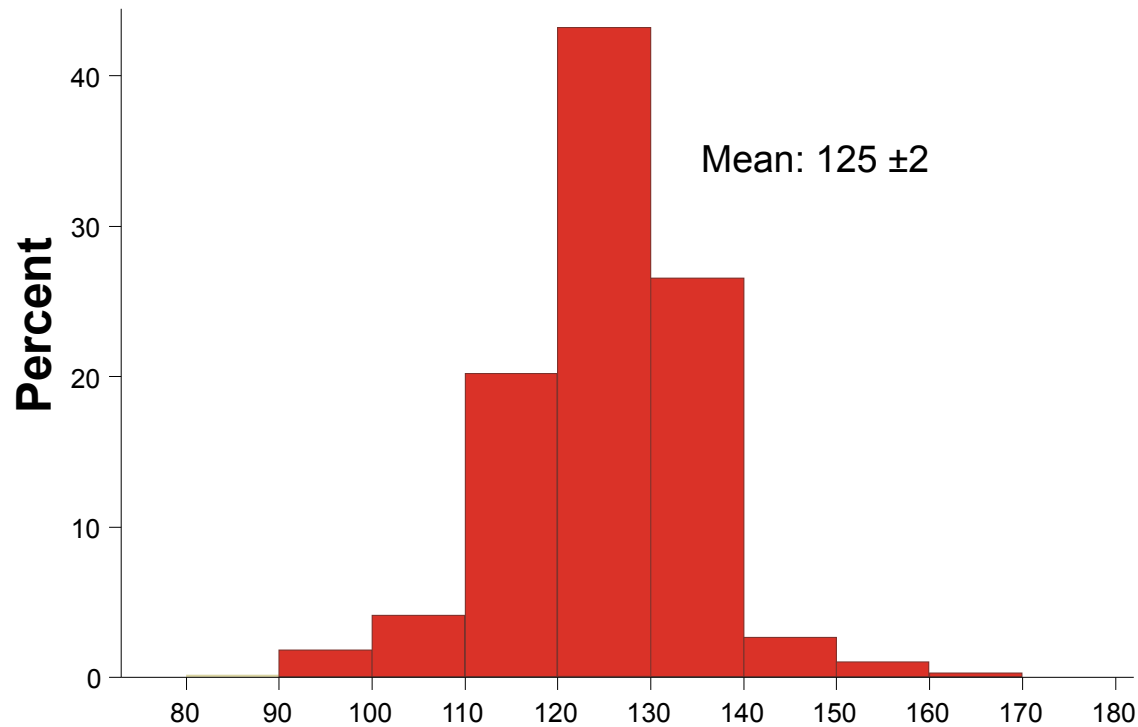


(Excludes indirect-fired systems that share a space heating system)





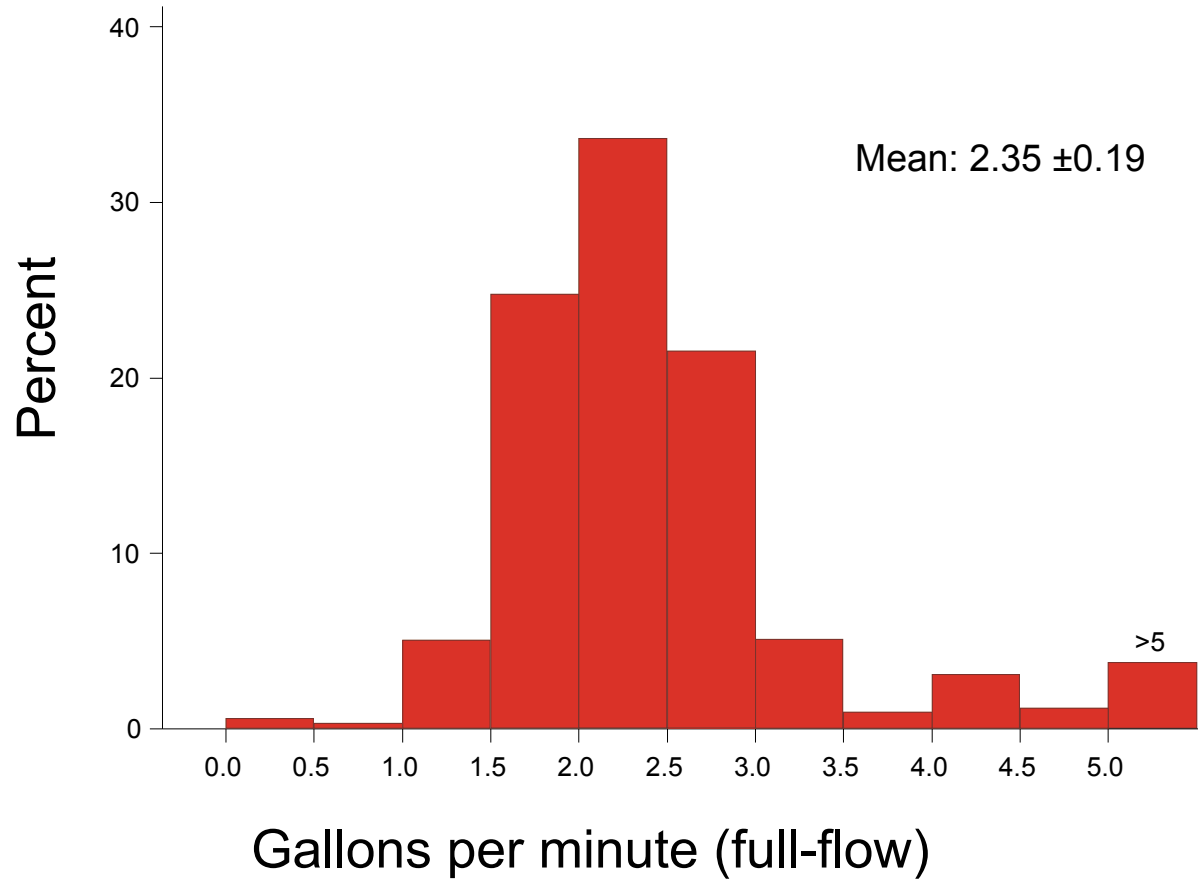
## Hot water delivery temperature



Hot-water temperature at kitchen sink (F)

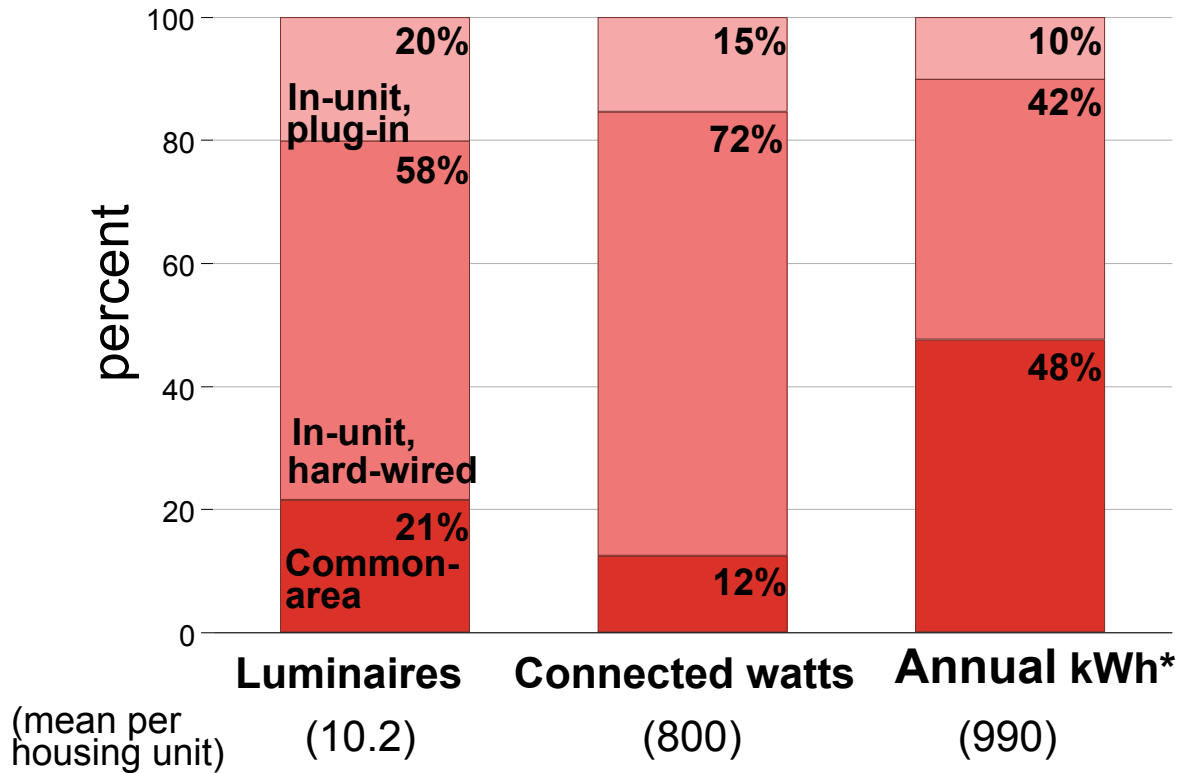
For measurements in 299 apartments

## Showerhead flow



For 331 measured showerheads

# Distribution of luminaires, watts and lighting energy



\*based on estimated operating hours

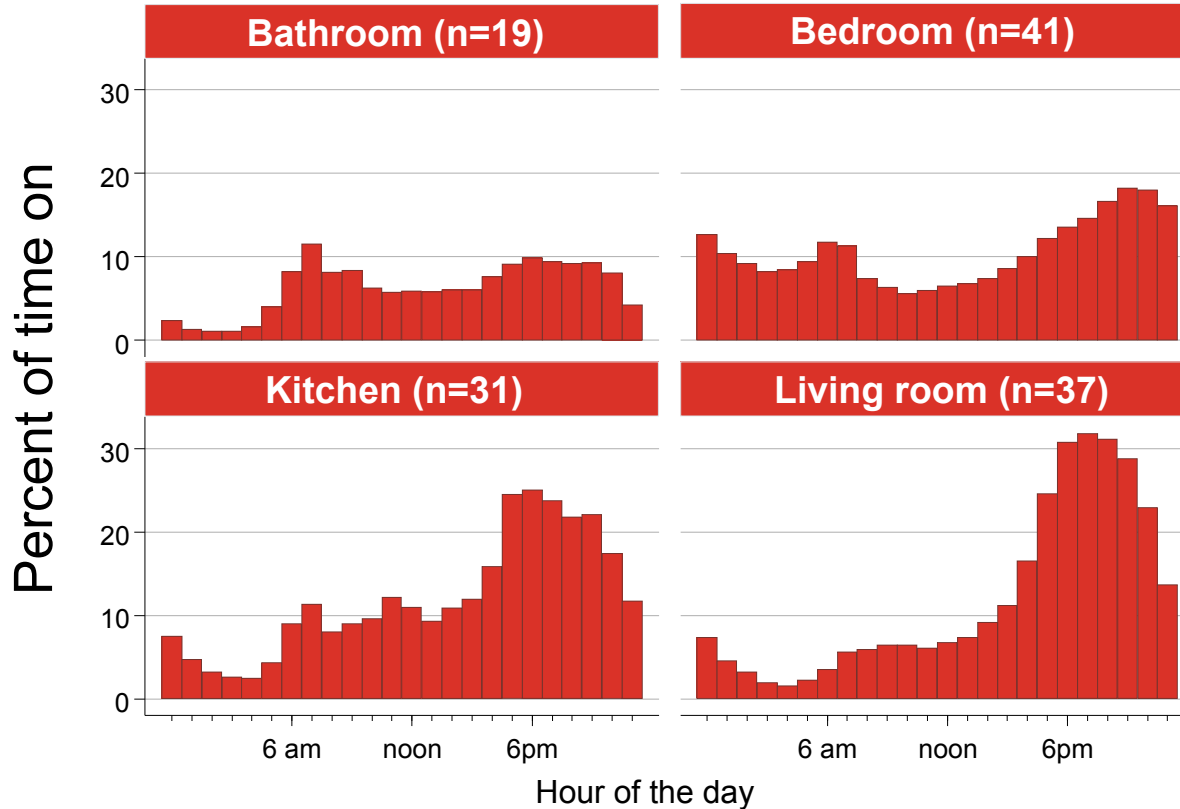
## Monitoring of in-unit lighting

Type	Location	Number in sample	Mean hours per day operated	
Hard-wired fixture	Kitchen	31	2.8	±1.2
	Bedroom	17	2.3	±1.1
	Bathroom	19	1.5	±0.9
Plug-in	Living room	35	2.6	±0.8
	Bedroom*	23	1.8	±1.4

± values are approximate 95% confidence intervals

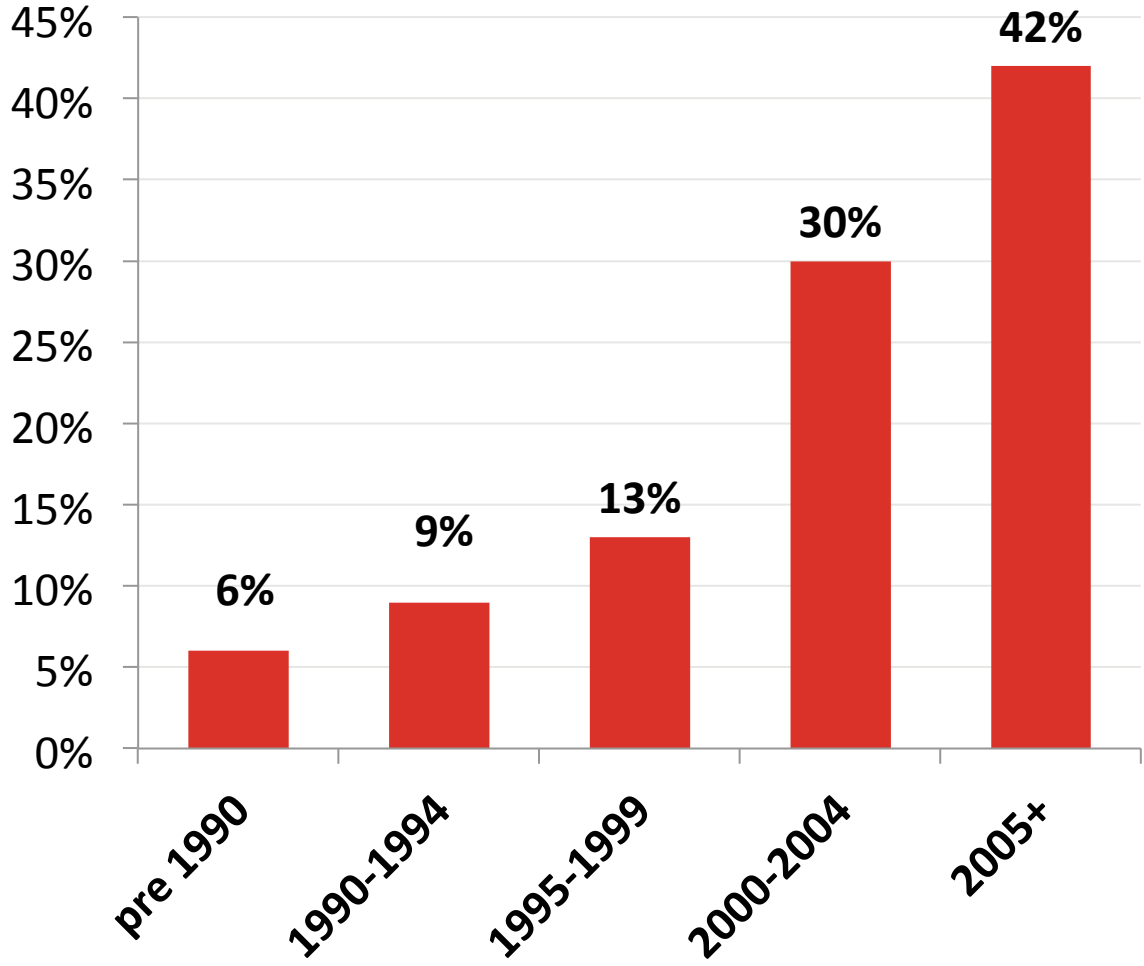
\*Excludes one luminaire that was operated 21 hours per day on average. Including this case raises the category average to 2.7±2.2 hours per day

# Monitoring of in-unit lighting



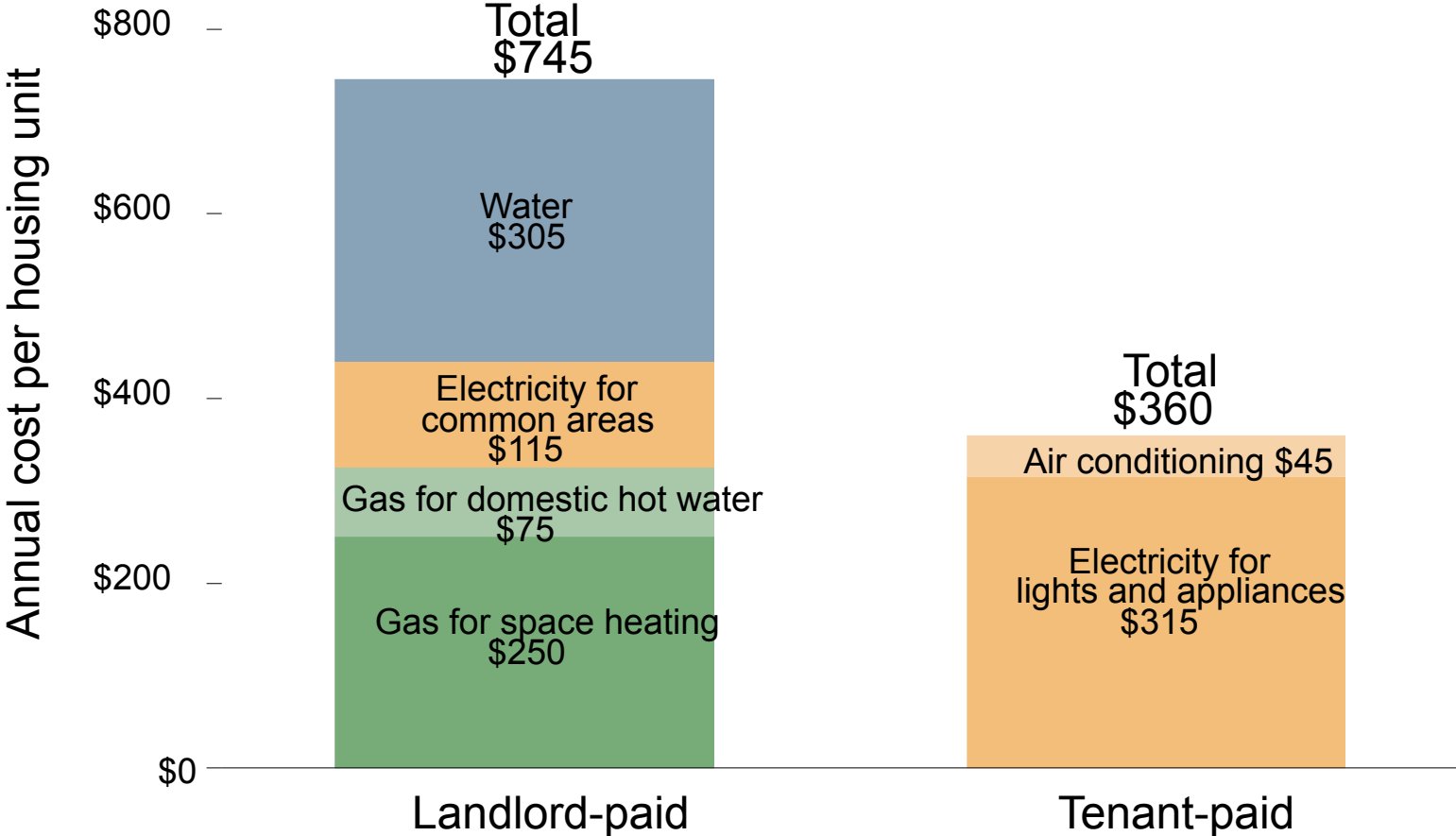
Combined results for hard-wired and plug-in luminaires

# Age of refrigerators



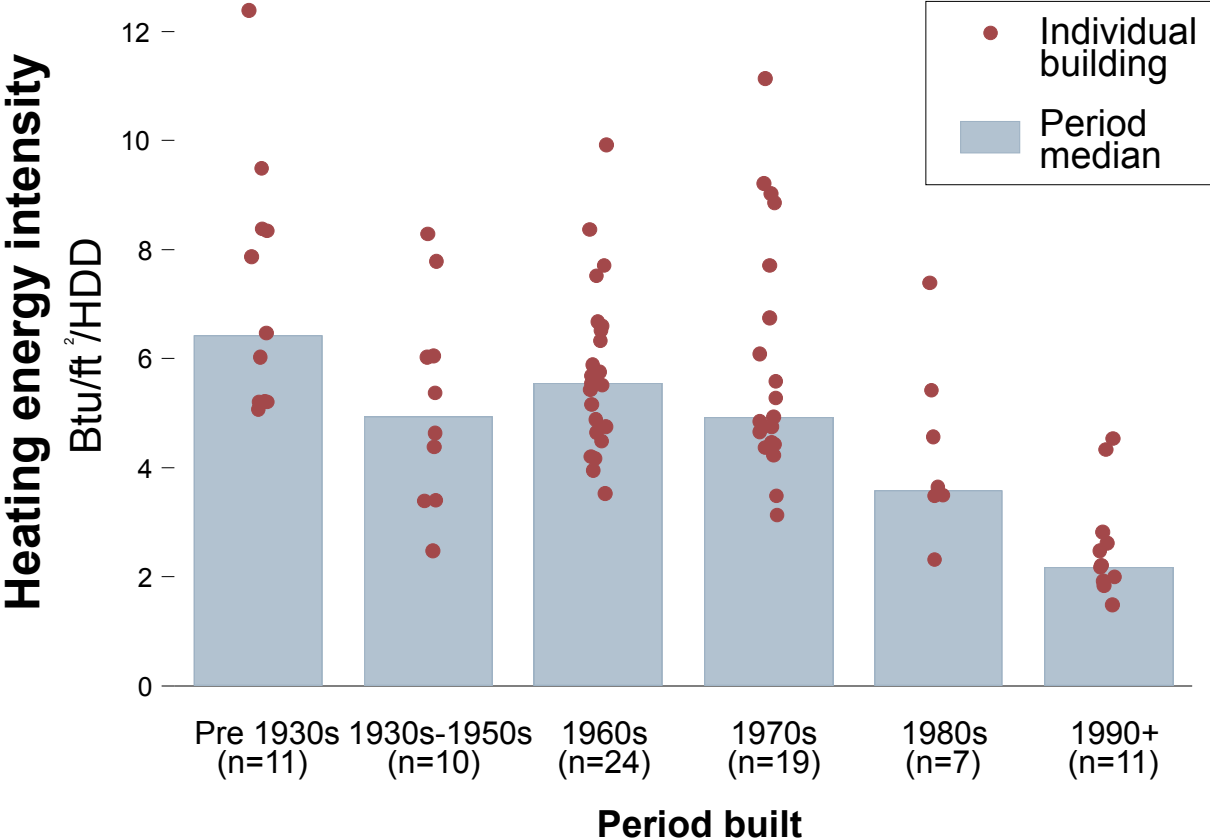
**ENERGY EFFICIENCY  
OPPORTUNITIES**

# Energy allocation





# Heating energy intensity



## **Energy efficiency opportunities**

- Lighting upgrades and bulb replacement
- High-efficiency heating systems
- High-efficiency water heaters
- Showerheads and faucet aerators
- Upgrading appliances
- Energy Star qualified windows

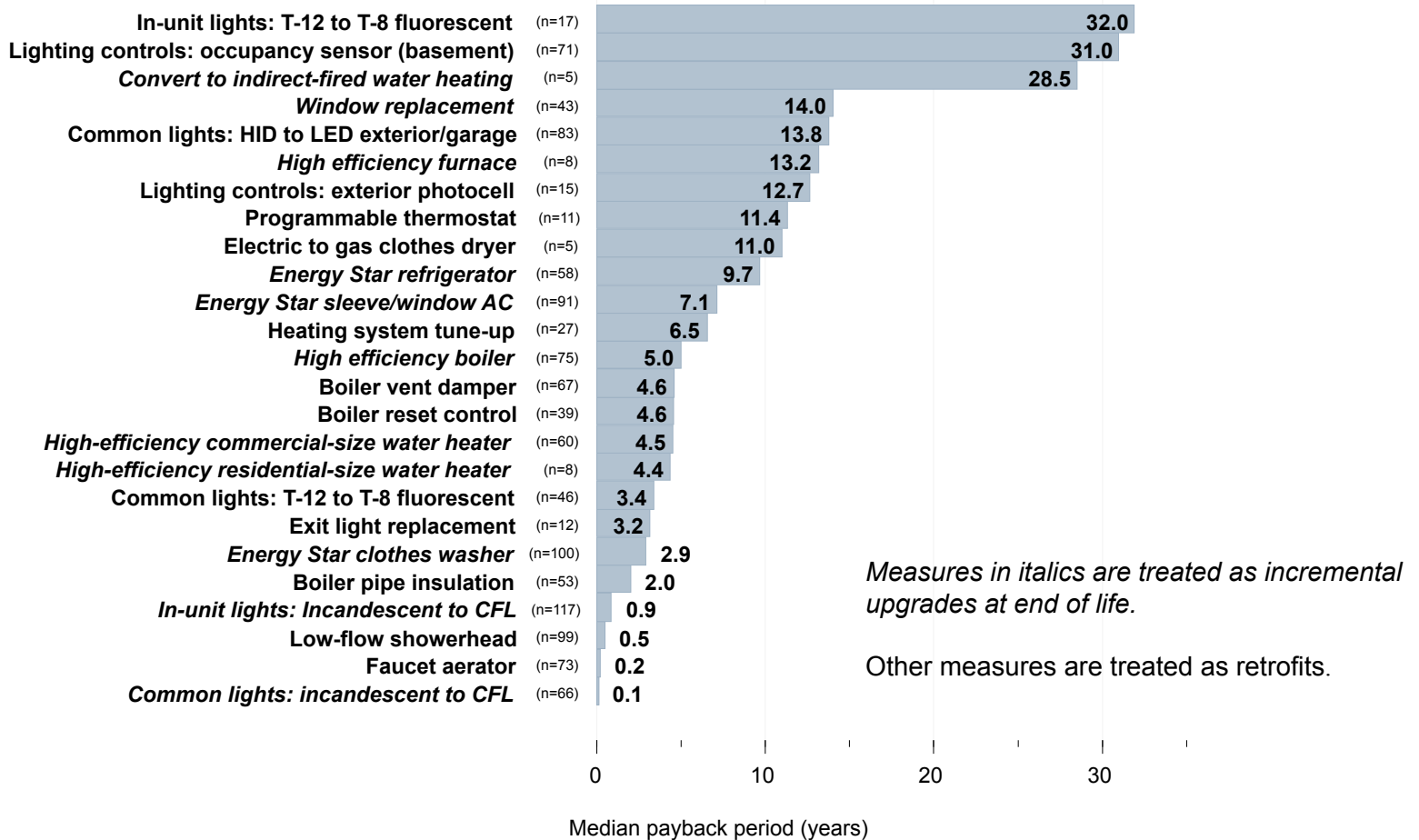
## Calculating payback

FULL RETROFIT

VS.

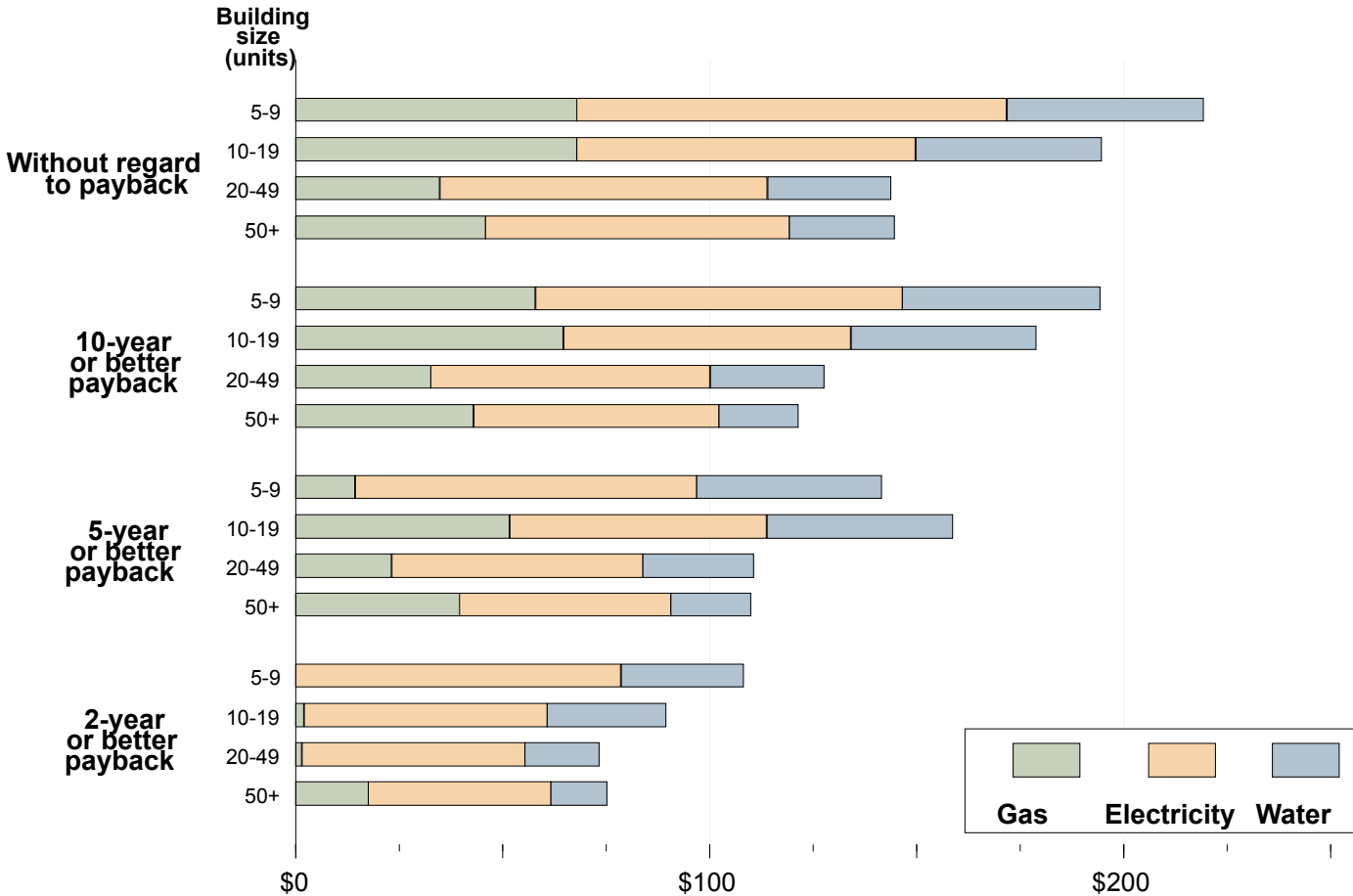
UPGRADE ON  
REPLACEMENT

# Median simple payback

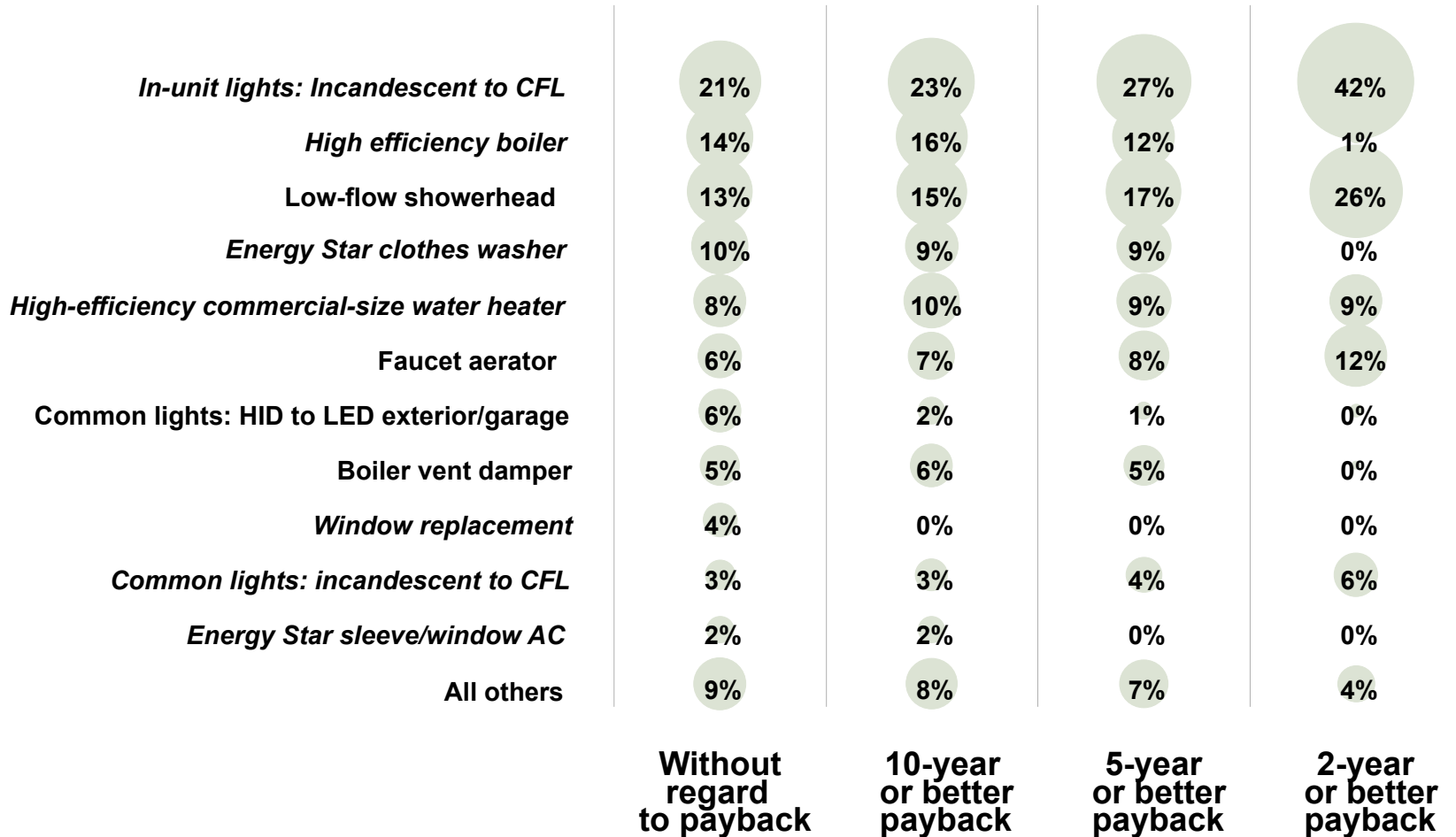


(n = number of buildings in study sample where measure was judged to be applicable)

# Annual savings per housing unit



# Measure contribution to aggregate cost savings potential



Columns sum to 100%

Area of shaded circles are proportional to column percents

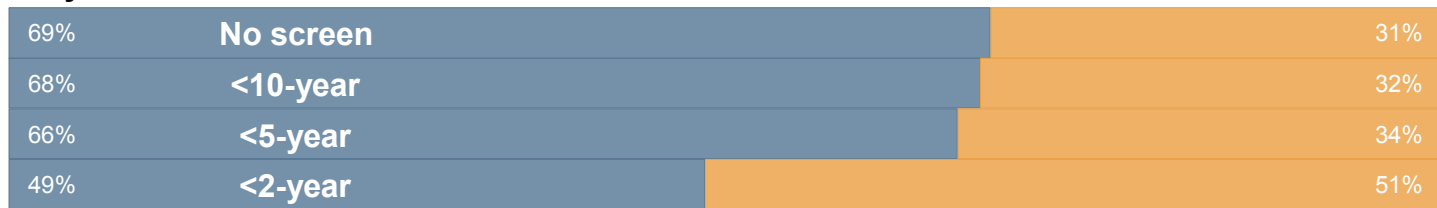
Measures in italics are treated as incremental upgrades at end of life. Other measures are treated as retrofits

# Landlord / tenant split

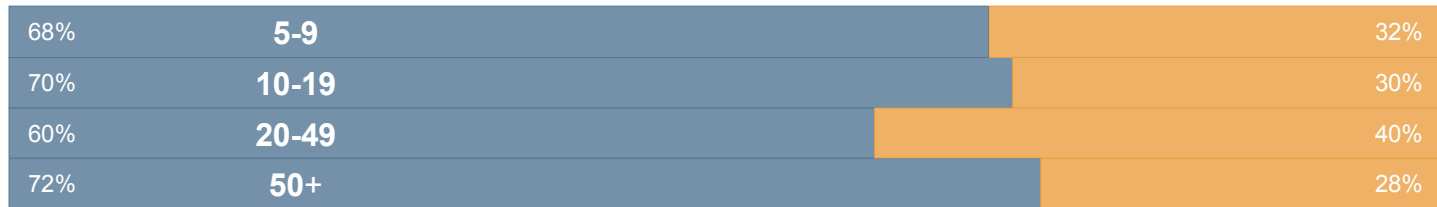
Landlord

Tenants

## Payback...



## Building size...



## Measure type...



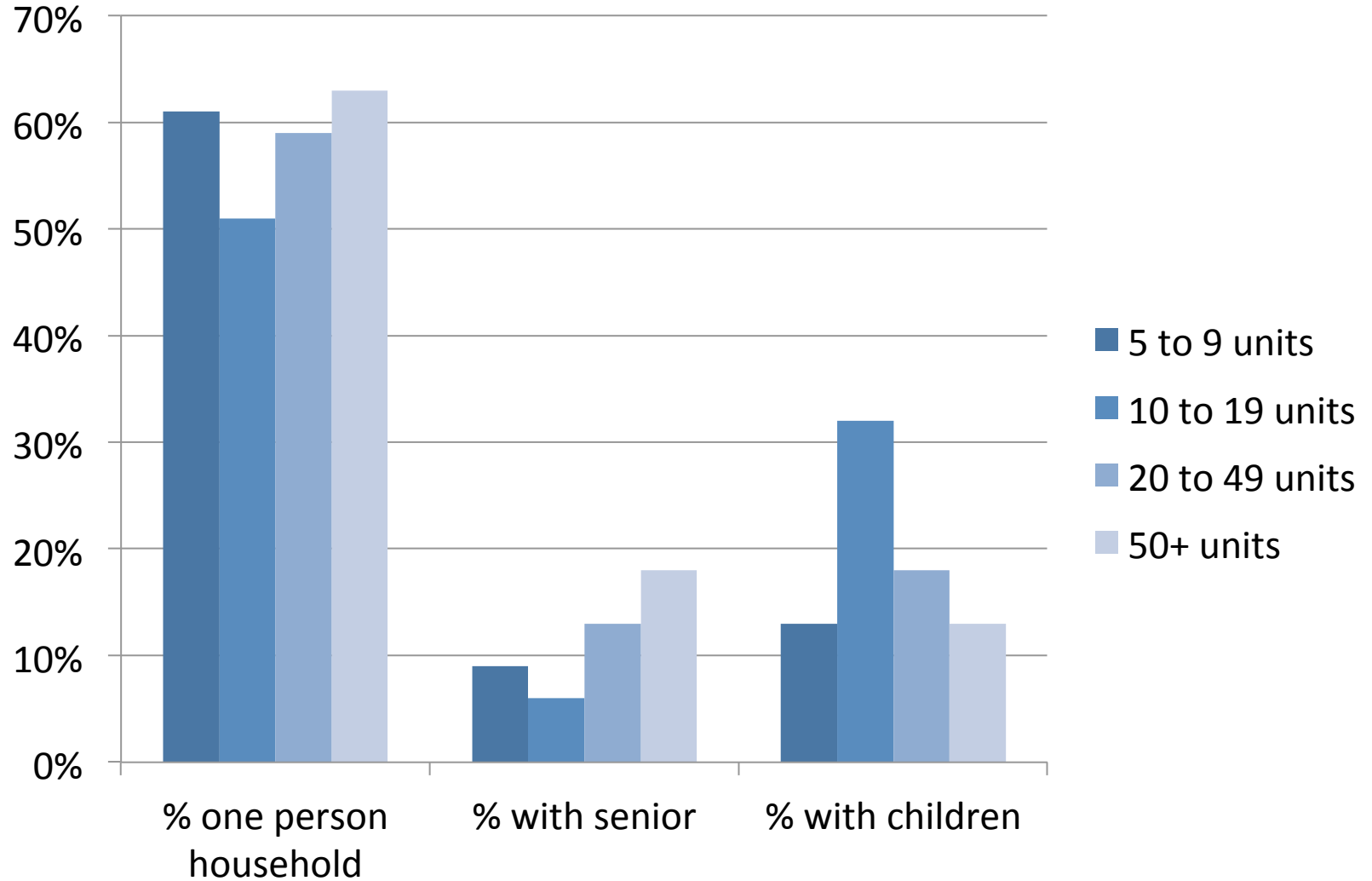
# Minnesota Multifamily Rental Characterization Study

## TENANT / OWNER ATTITUDES

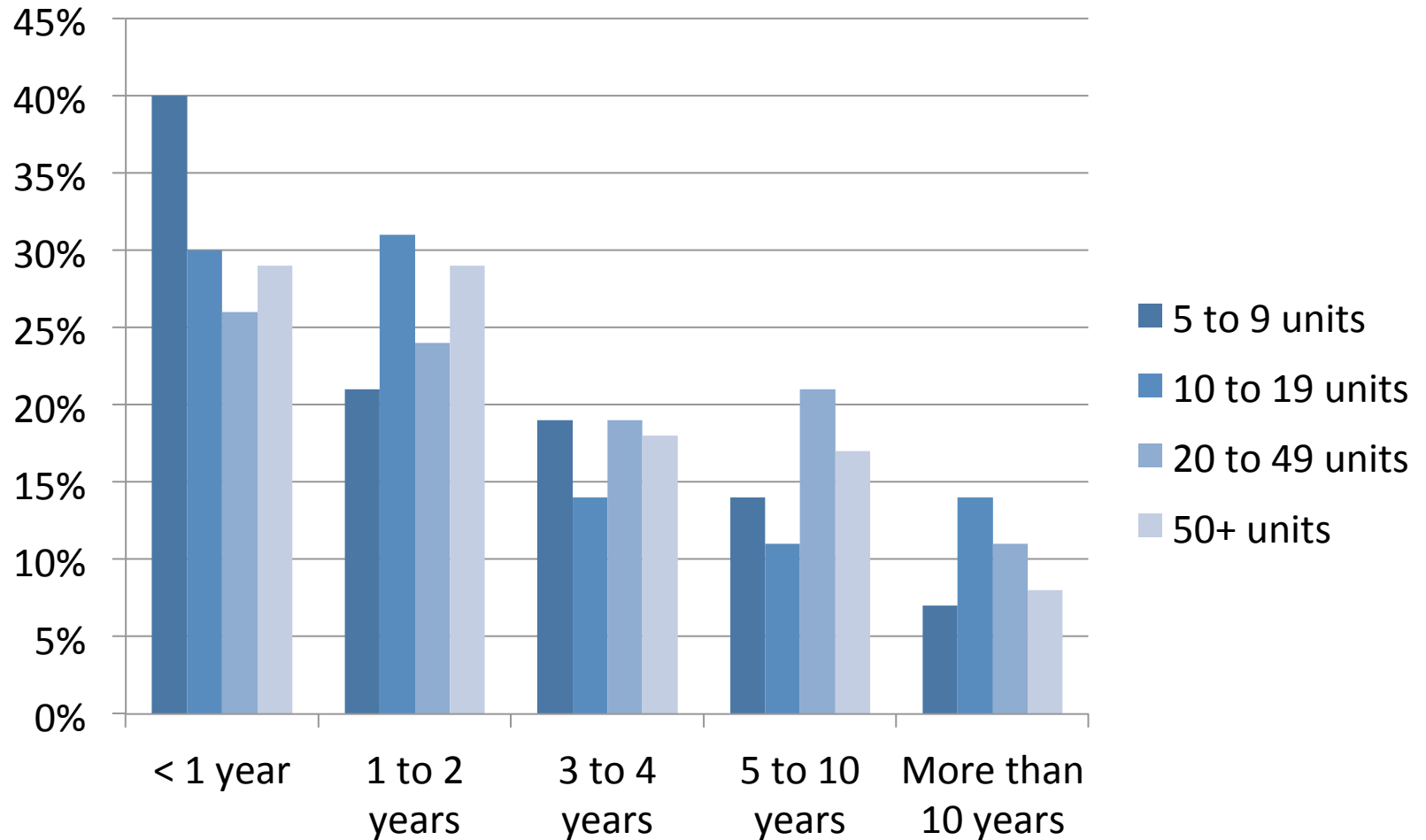




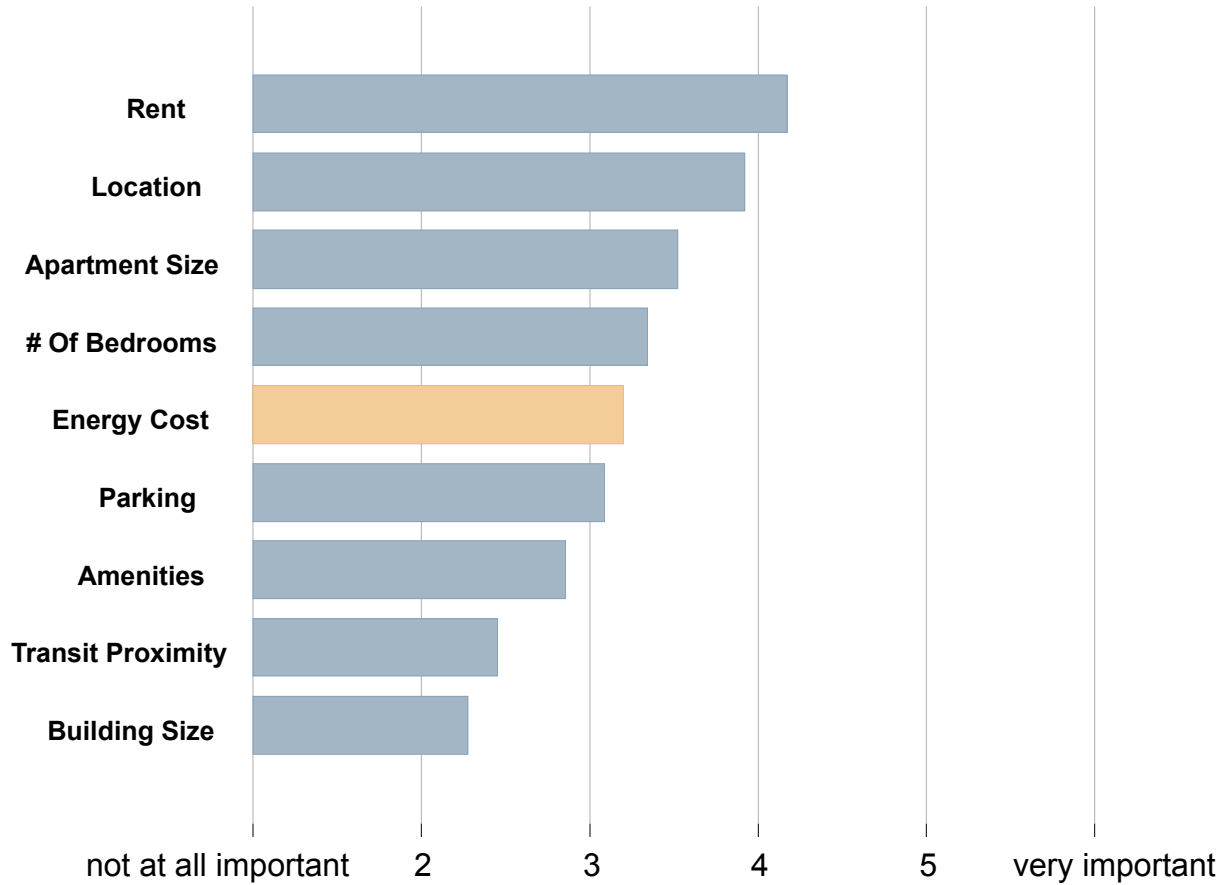
## Household composition



## Years in current unit

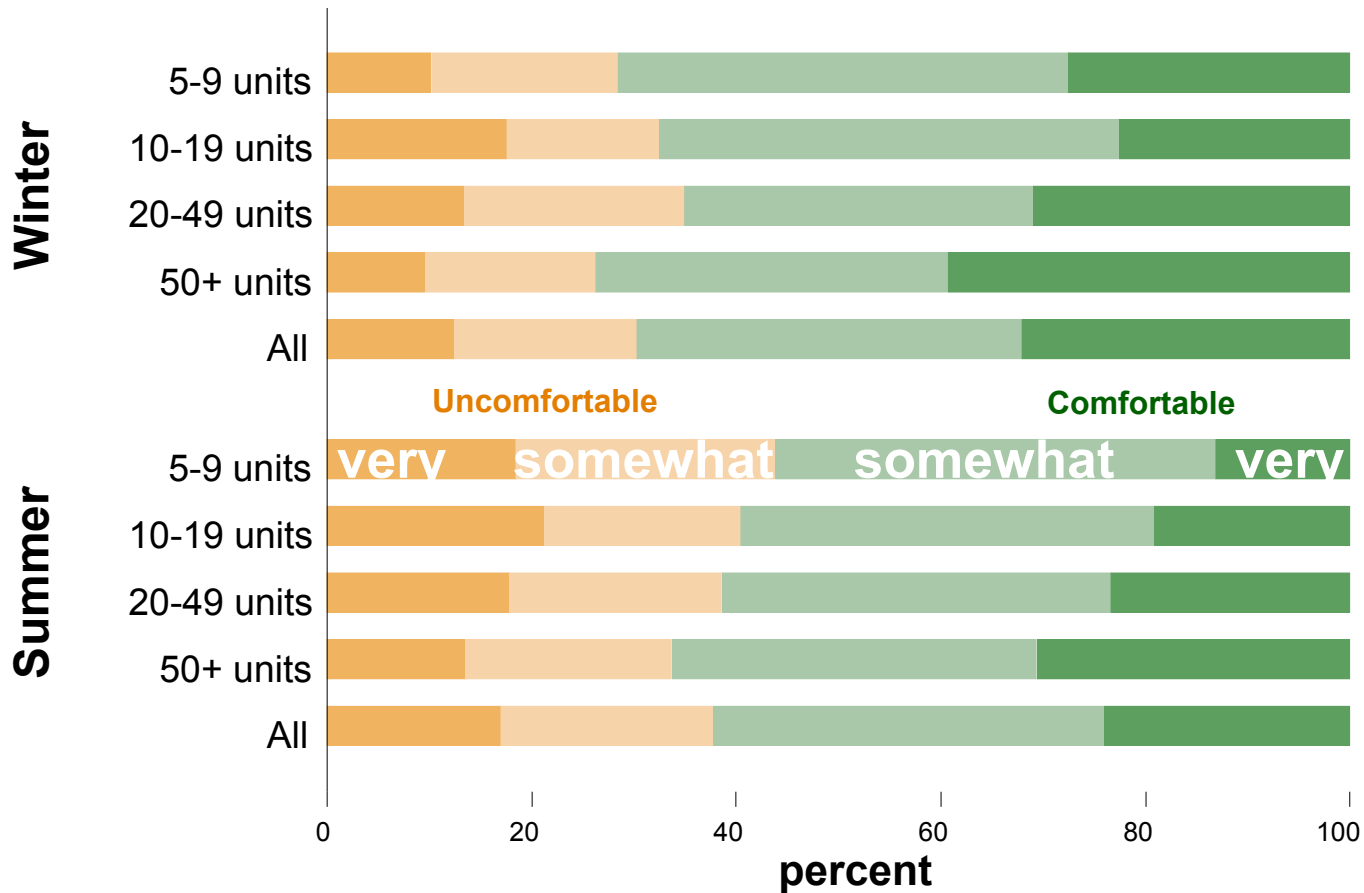


## Factors in deciding where to rent



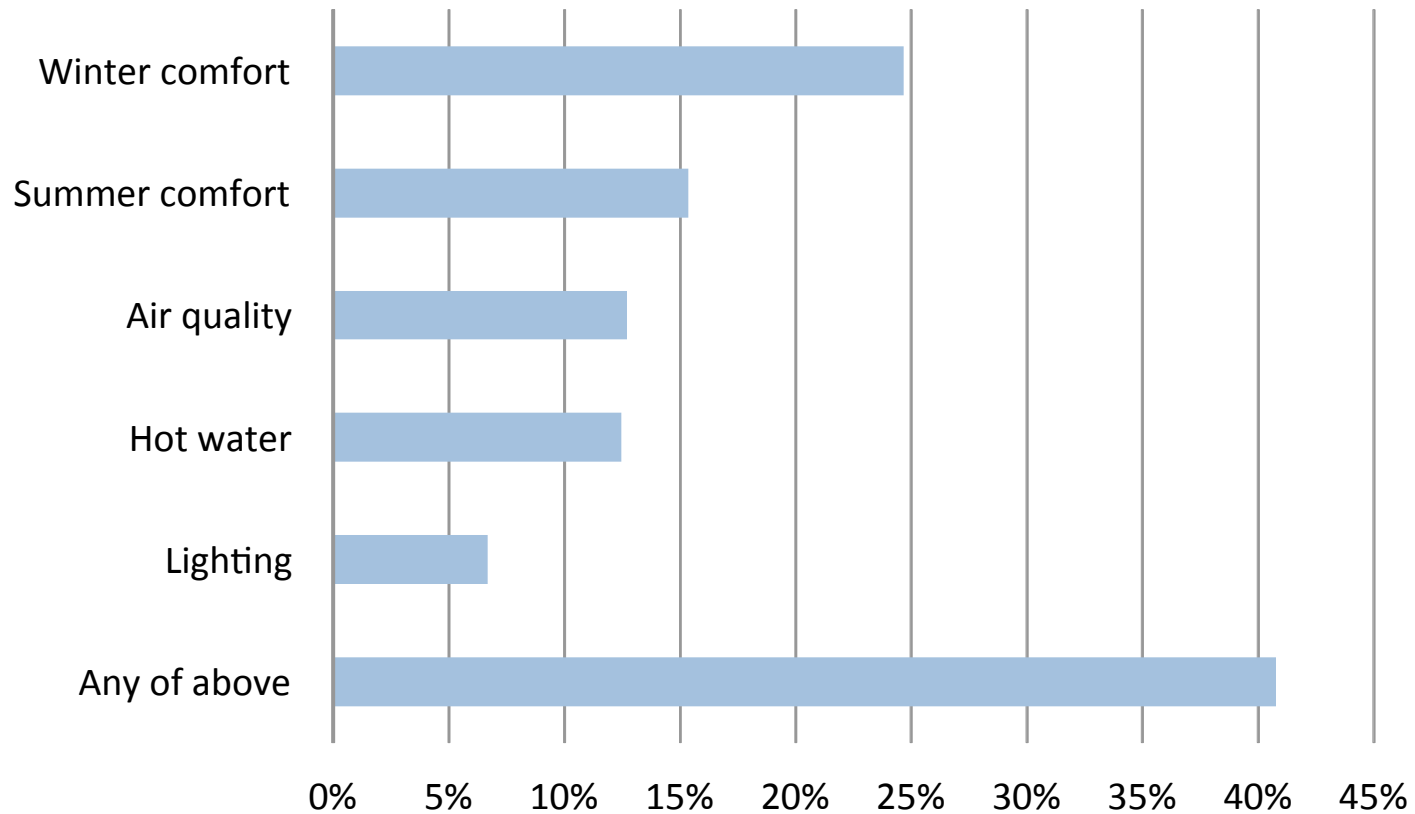
# Comfort levels between summer and winter

How would you describe the general level of comfort in your apartment unit in winter/summer?

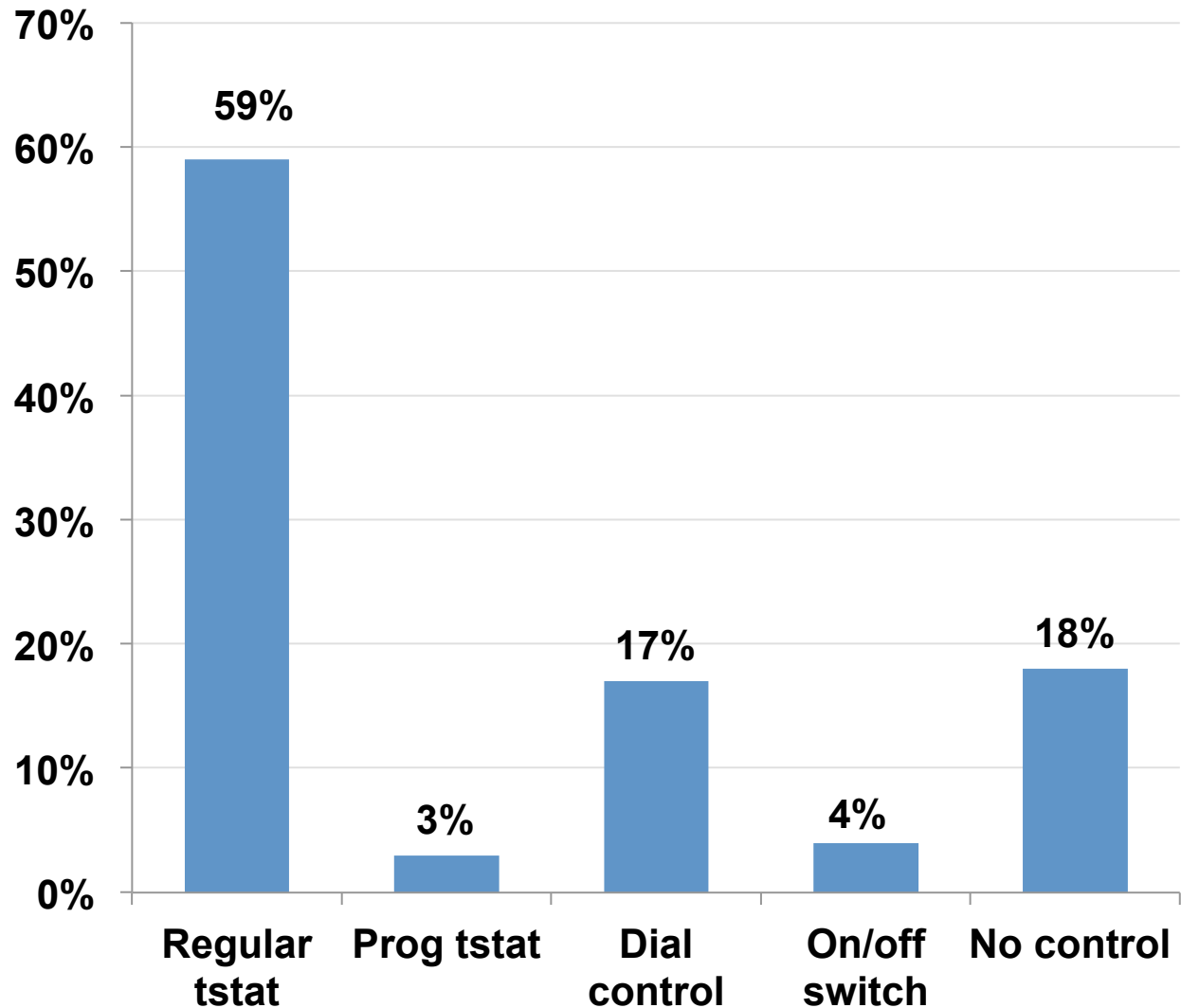


n= 1,045 (winter); 1,074 (summer)

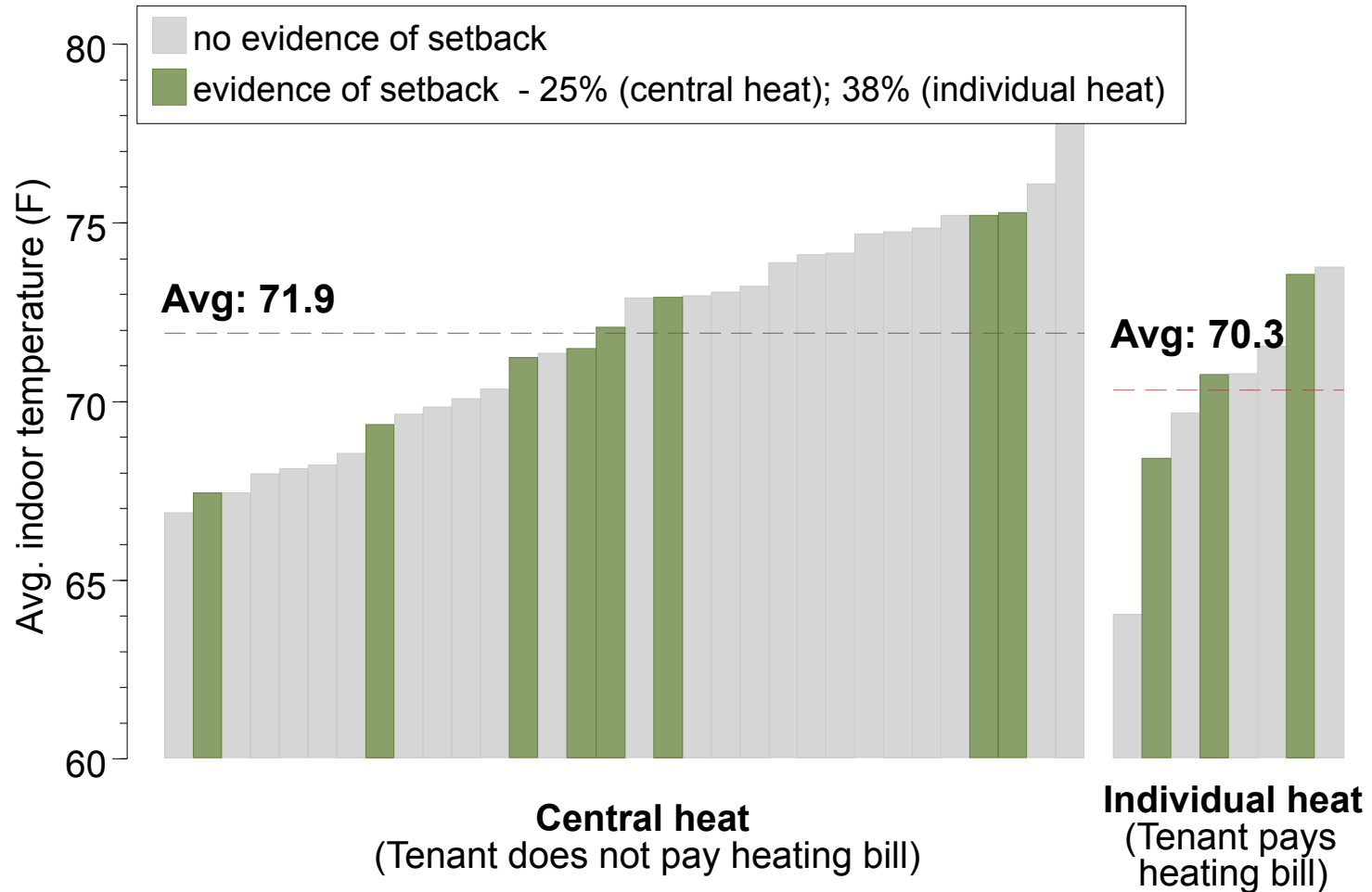
## Incidence of reporting comfort issue



## Type of temperature control



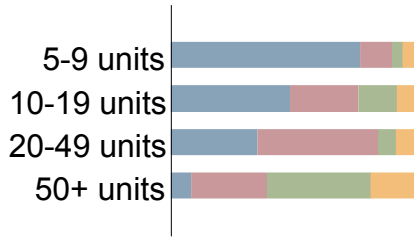
## Evidence of setback



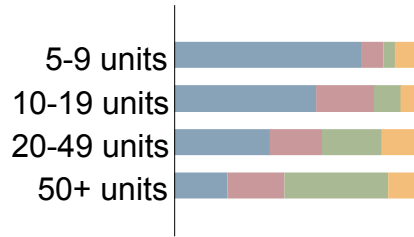
By apartment, sorted from lowest to highest temperature within heating type.  
Normalized to average Dec-Feb outdoor temperature

## Who is likely to have the largest say in...

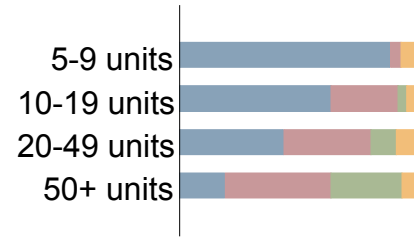
Replacing in-unit appliances



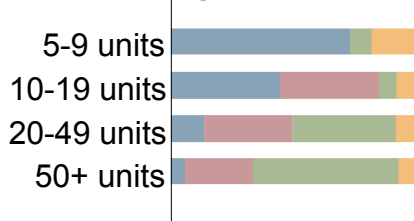
Replacing hallway lighting



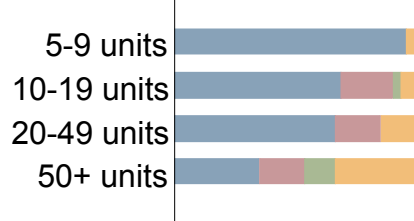
Purchasing new water heater



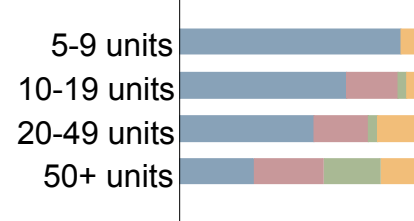
Painting an apartment



Roofing

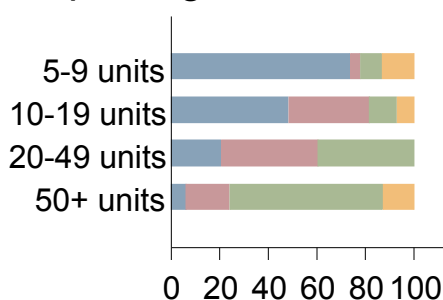


Replacing a furnace or boiler

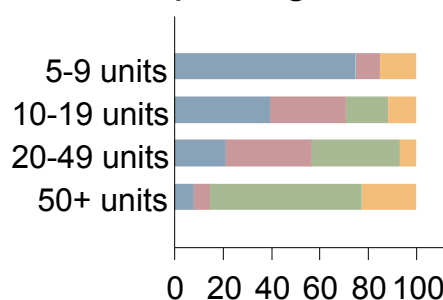


0 20 40 60 80 100

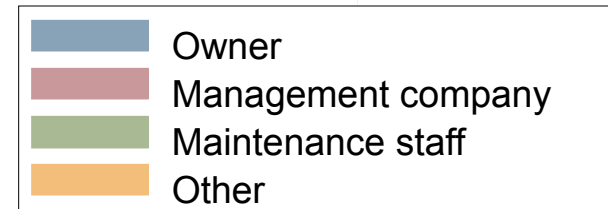
Replacing bath/kitchen fixture



Replacing window/wall A/C unit

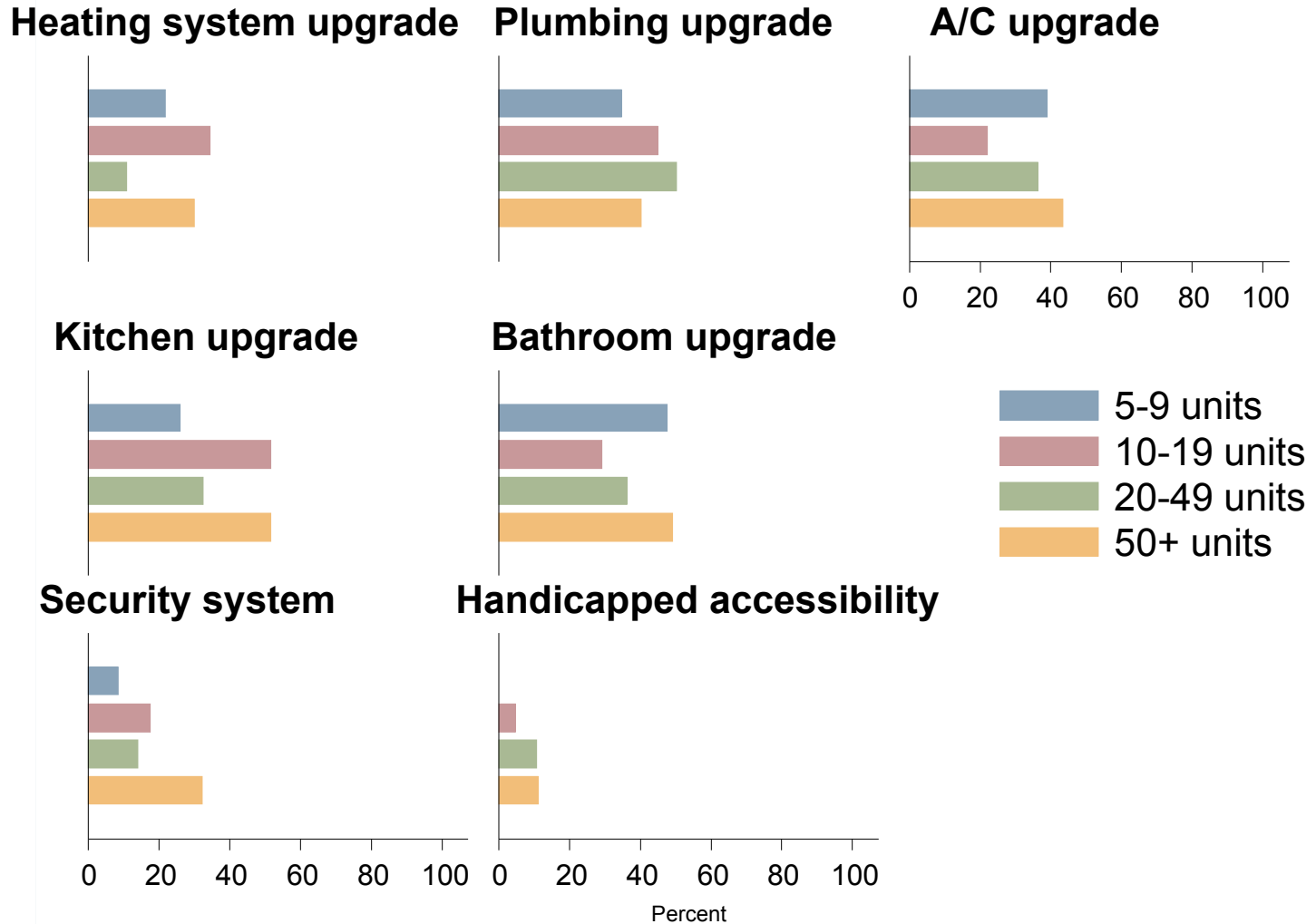


Percent

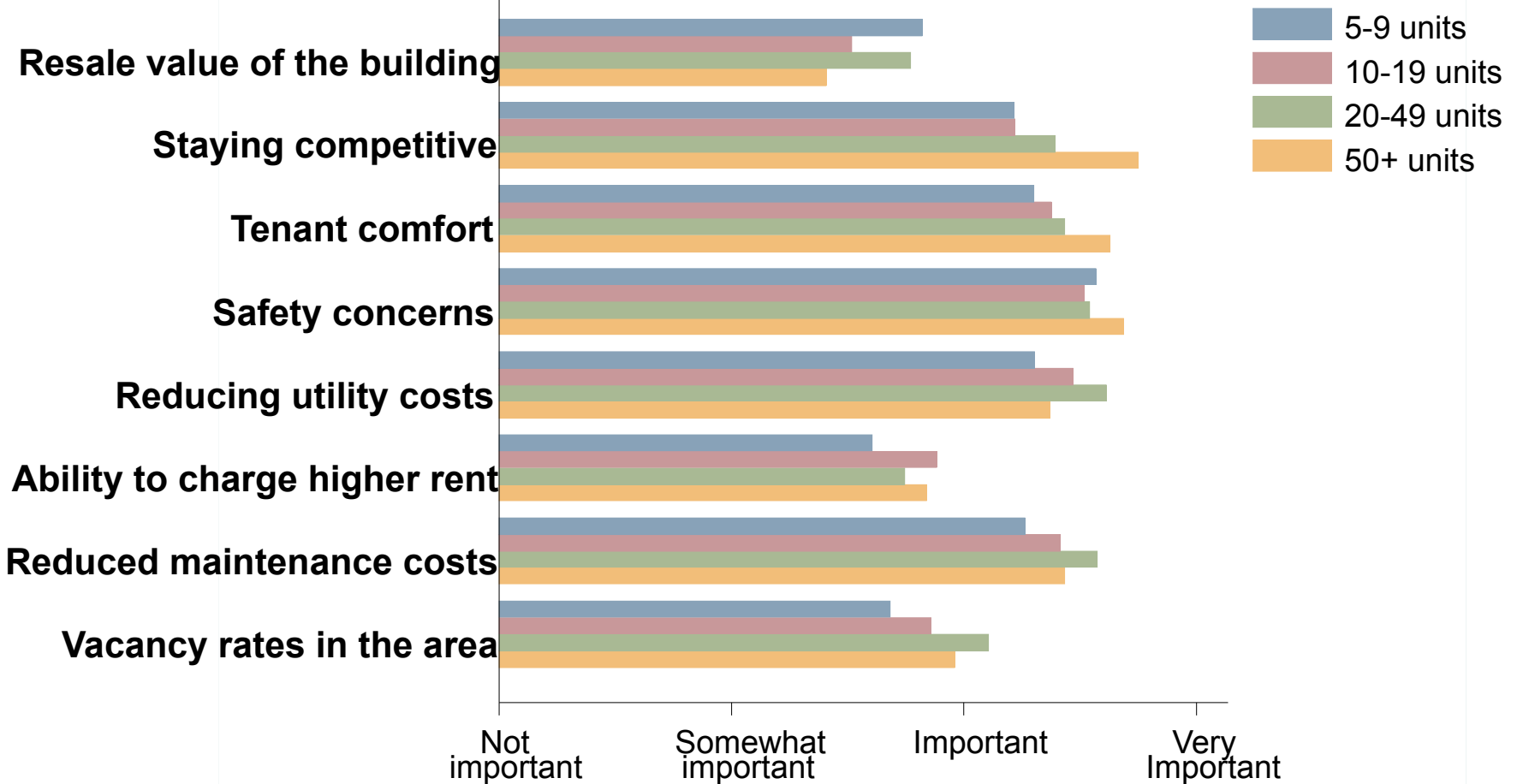




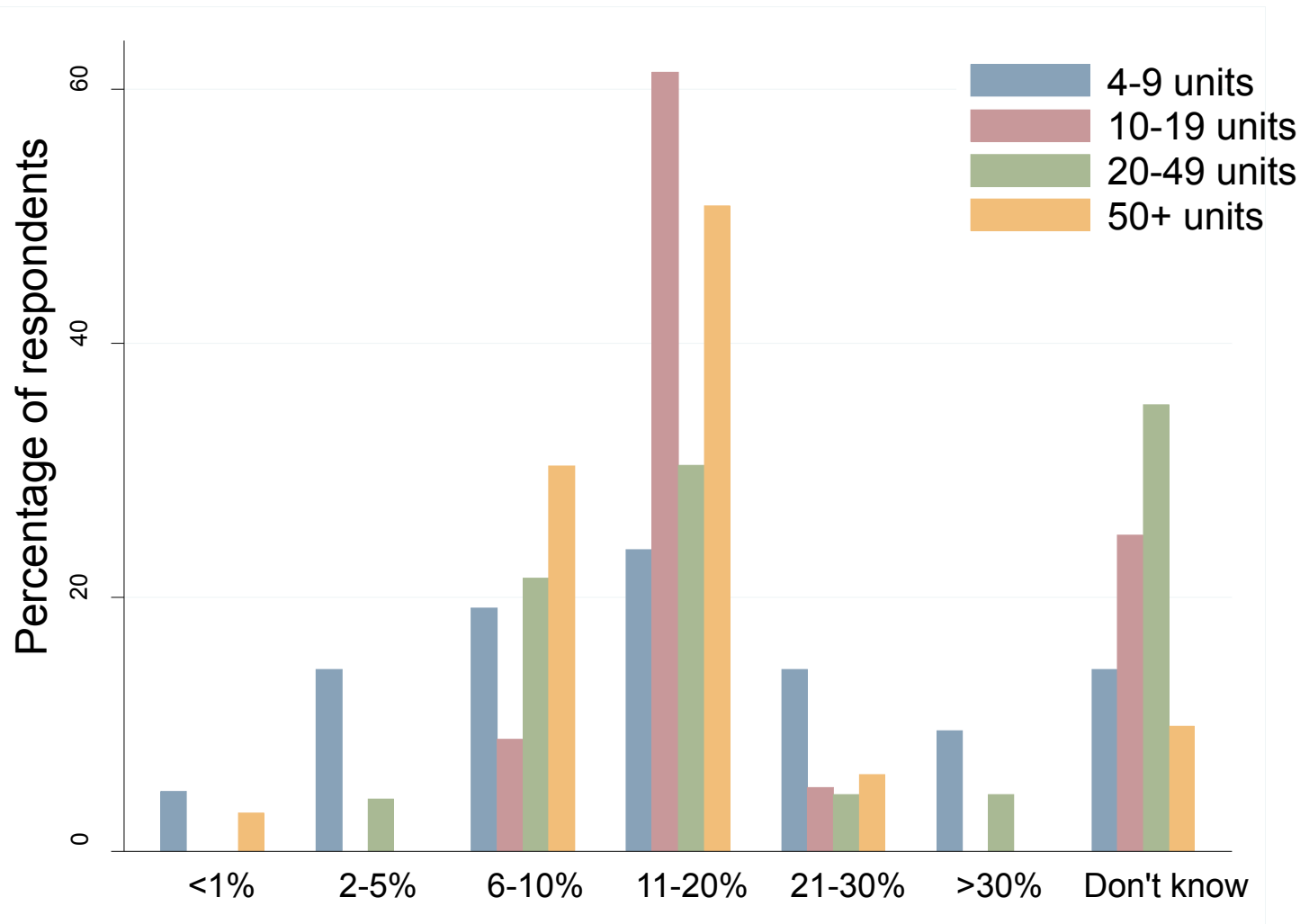
# Changes expected



## Factors in deciding to make a change



## Energy costs in relation to other costs



# Minnesota Multifamily Rental Characterization Study

<http://ecw.org/mn-multifamily-rental-char-study>

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