

# Minnesota Multifamily Rental Characterization Study

Jeannette LeZaks February 25, 2014

**Duluth Energy Design Conference** 

www.ecw.org

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."

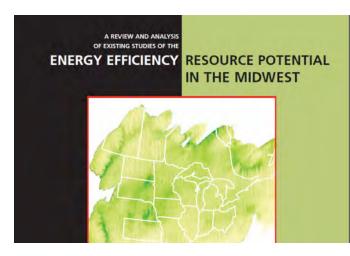
For additional continuing education approvals, please see your credit tracking card.

#### OVERVIEW

## ABOUT THE ENERGY CENTER

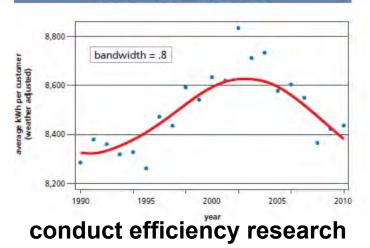


#### educate energy professionals



prepare policy analyses

Non-parametric regression fit to residential electricity use per customer, Wisconsin, 1990–2010



#### RESEARCH

#### EDUCATION

#### DESIGN ASSISTANCE

POLICY ANALYSIS



design efficient buildings



**PROJECT PARTNERS** 



Conservation Applied Research & Development (CARD) Program



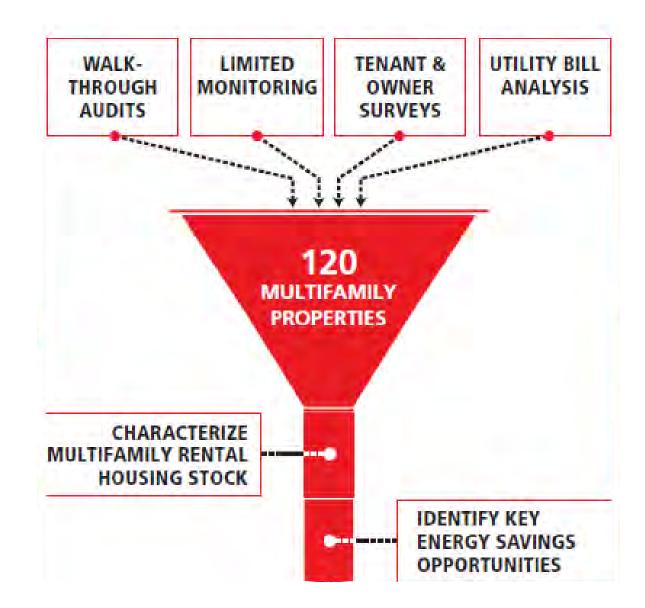


- Characterize the MN MF
  building stock
- Benchmark energy use
- Assess efficiency
  opportunities
- Explore attitudes and behavior of tenants and owners/managers



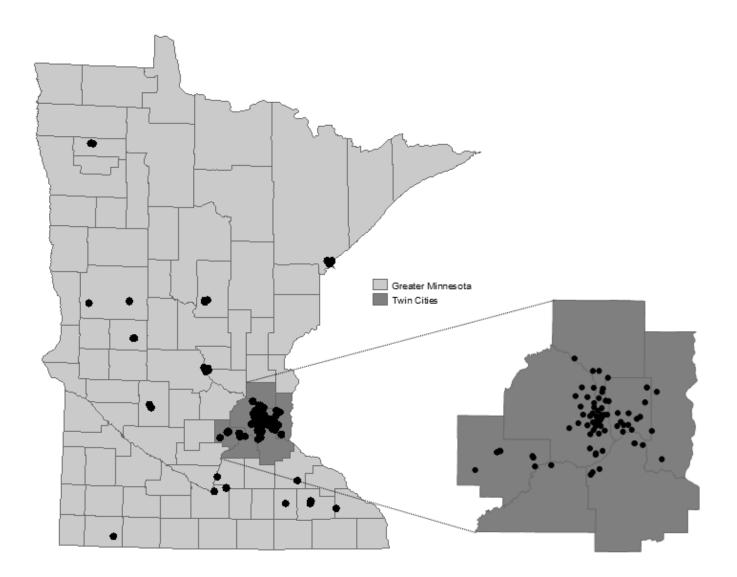
#### **OVERVIEW**

#### BACKGROUND



#### OVERVIEW

## BACKGROUND



#### BACKGROUND



# 5 to 9 unit buildings



# 10 to 19 unit buildings



# 20 to 49 unit buildings



# **50+ unit buildings**







# **PRE-WORLD WAR II**



**BUILDING AGE GROUPS** 

## **POST-WORLD WAR II**





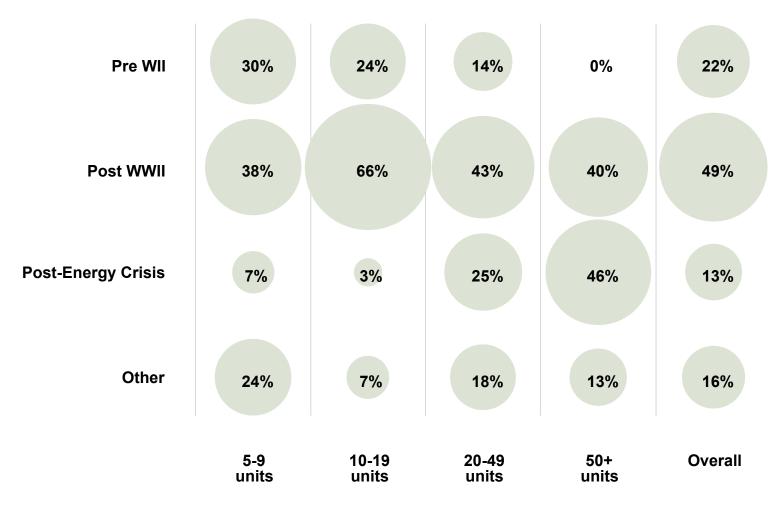
**BUILDING AGE GROUPS** 

# **POST ENERGY CRISIS**



**OVERVIEW** 

#### **BUILDING AGE GROUPS**

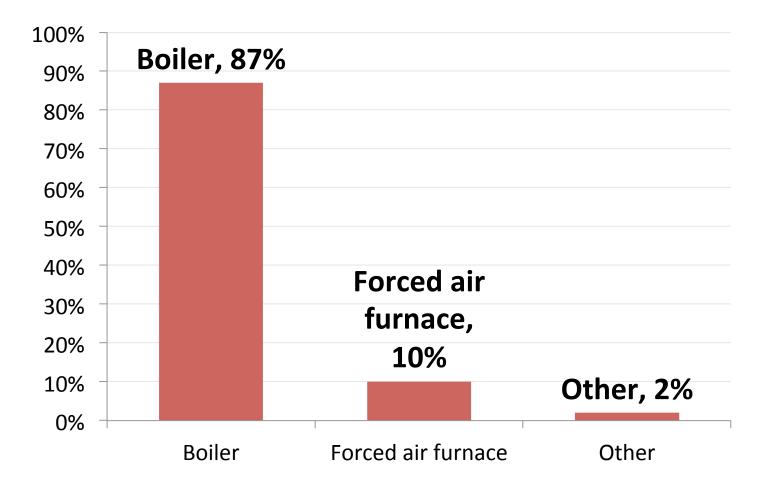


Columns sum to 100% Area of shaded circles are proportional to column percent

# Minnesota Multifamily Rental Characterization Study

# BUILDING CHARACTERISTICS

# **OVERALL TYPE**



HYDRONIC HEATING SYSTEMS

# **Energy related features**

## EFFICIENCY CLASS

## **VENT DAMPERS**

## CONTROLS



HYDRONIC HEATING SYSTEMS

# **Energy related features**

## EFFICIENCY CLASS

## **VENT DAMPERS**

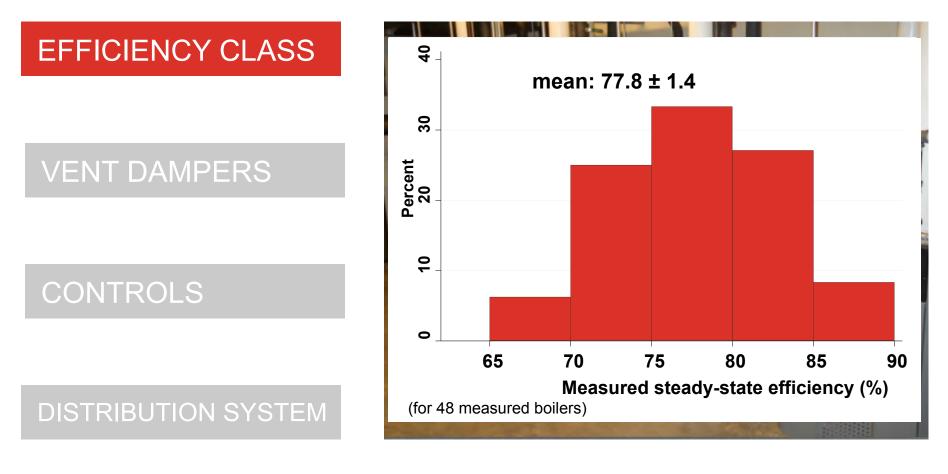
#### CONTROLS



HYDRONIC HEATING SYSTEMS **CHARACTERISTICS** 

BUILDING

# **Energy related features**



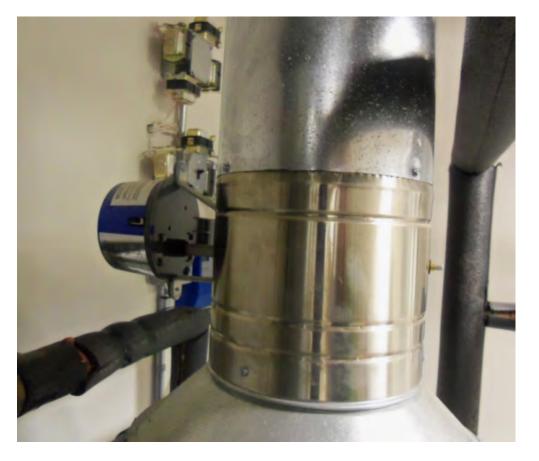
HYDRONIC HEATING SYSTEMS

# **Energy related features**

### EFFICIENCY CLASS

## **VENT DAMPERS**

#### CONTROLS



HYDRONIC HEATING SYSTEMS

# **Energy related features**

## EFFICIENCY CLASS

### **VENT DAMPERS**

## CONTROLS



HYDRONIC HEATING SYSTEMS

# **Energy related features**

## EFFICIENCY CLASS

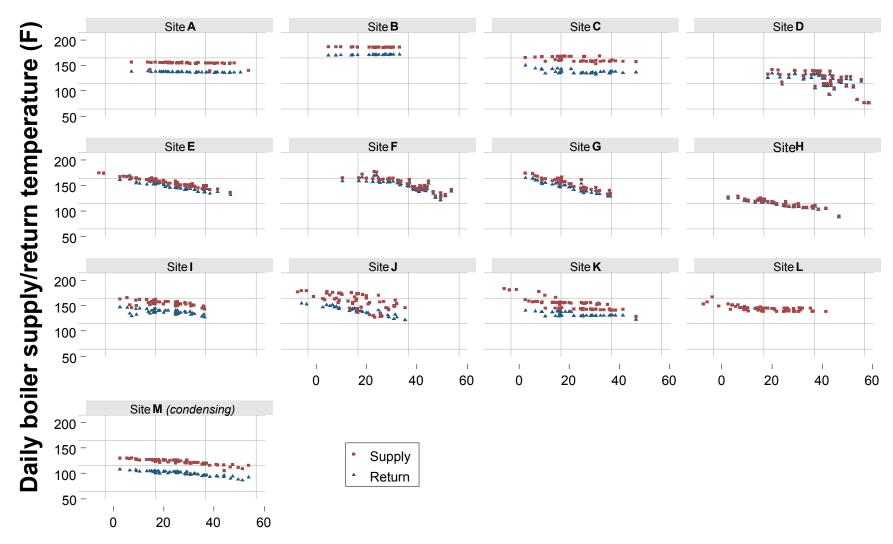
#### **VENT DAMPERS**

#### CONTROLS



## HYDRONIC HEATING SYSTEMS

# **Supply – return measurements**



Daily outdoor temperature (F)

## **AIR CONDITIONING**

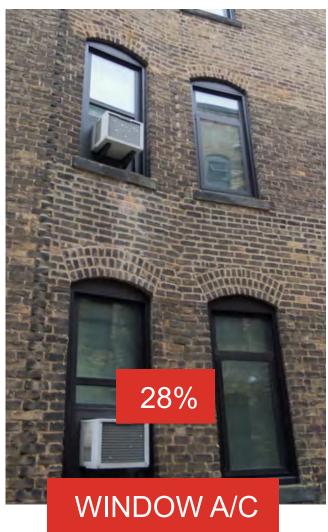
# **Common types of A/C units**





## **AIR CONDITIONING**

# **Common types of A/C units**





## **AIR CONDITIONING**

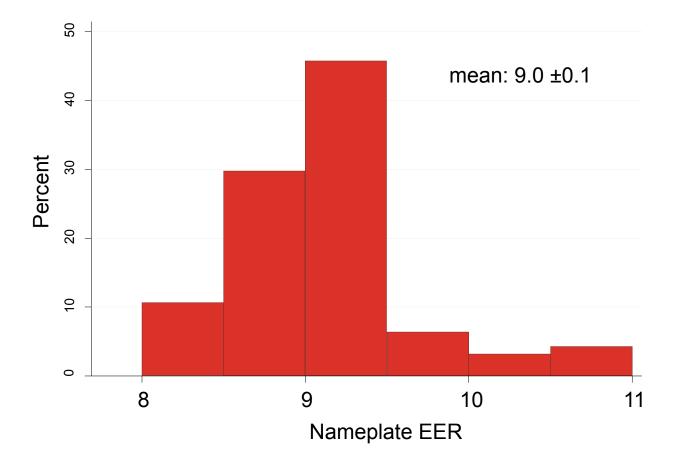
# **Common types of A/C units**

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





# Nameplate capacity



For 94 units with nameplate information.

# **Common types**



# **Common types**

#### Individual conventional tank

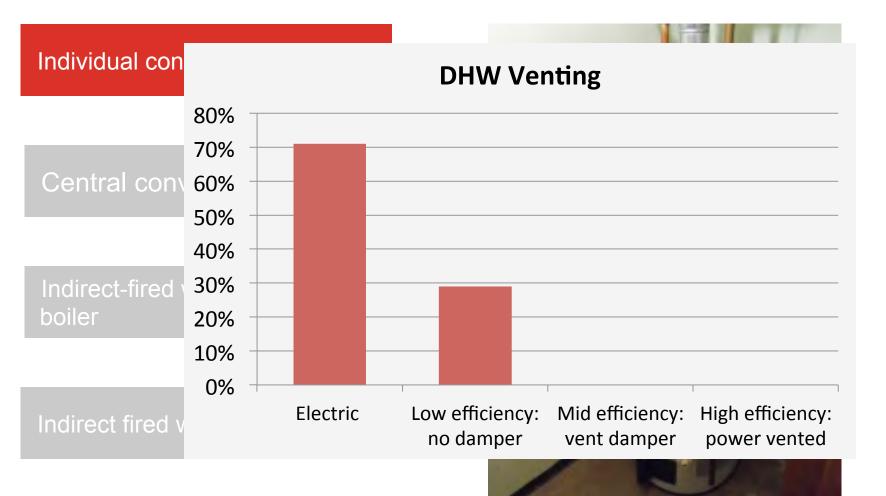
Central conventional tank

Indirect-fired with dedicated boiler

Indirect fired with shared boiler



# **Common types**



# **Common types**

#### Individual conventional tank

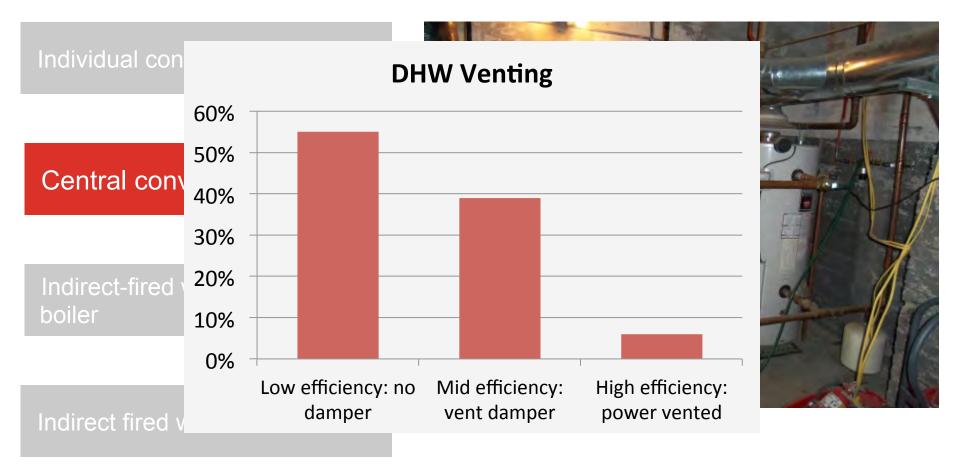
#### Central conventional tank

Indirect-fired with dedicated boiler

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# **Common types**



# **Common types**

#### Individual conventional tank

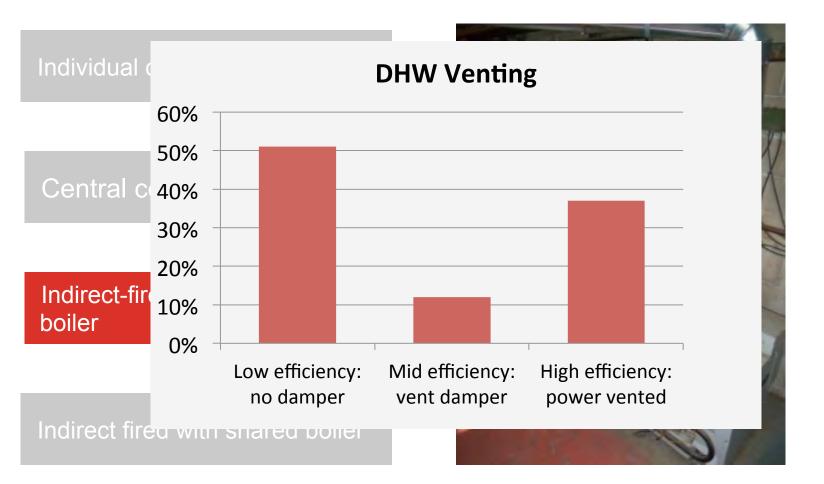
#### Central conventional tank

Indirect-fired with dedicated boiler

Indirect fired with shared boiler



# **Common types**



#### BUILDING CHARACTERISTICS

## **Common types**

#### Individual conventional tank

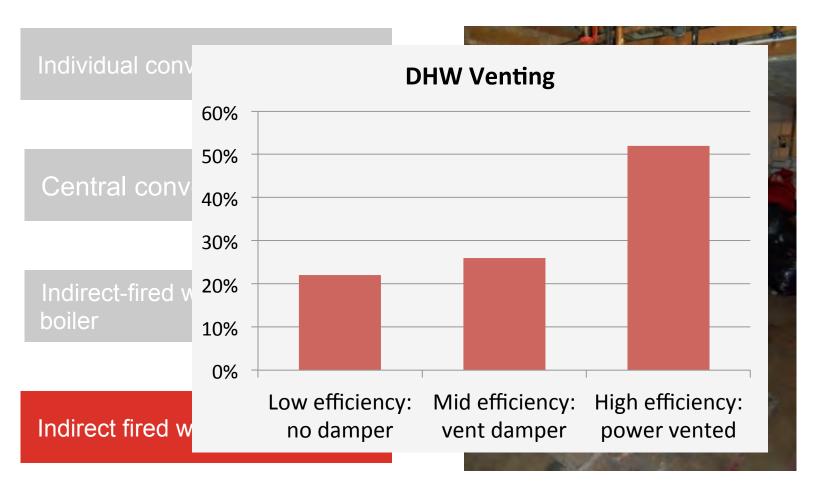
Central conventional tank

Indirect-fired with dedicated boiler

Indirect fired with shared boiler

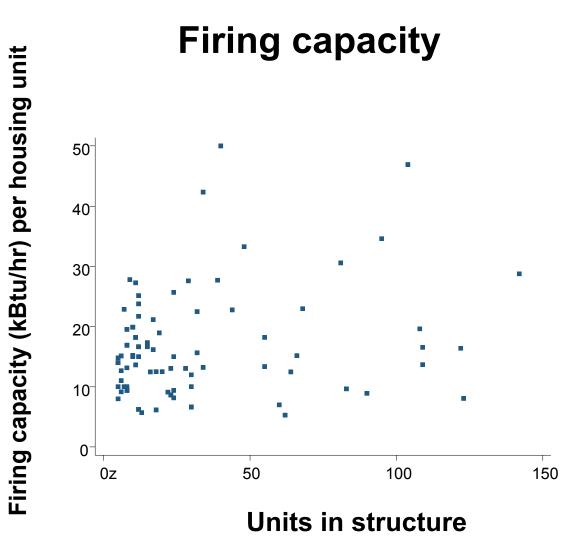


## **Common types**



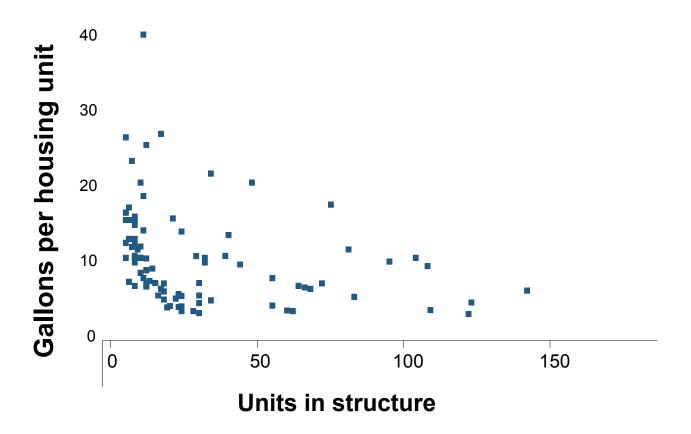
#### BUILDING CHARACTERISTICS

#### WATER HEATERS



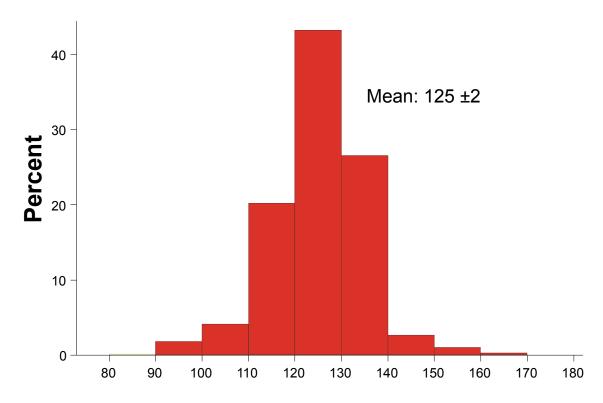
(Excludes indirect-fired systems that share a space heating system)

## **Storage capacity**



BUILDING CHARACTERISTICS

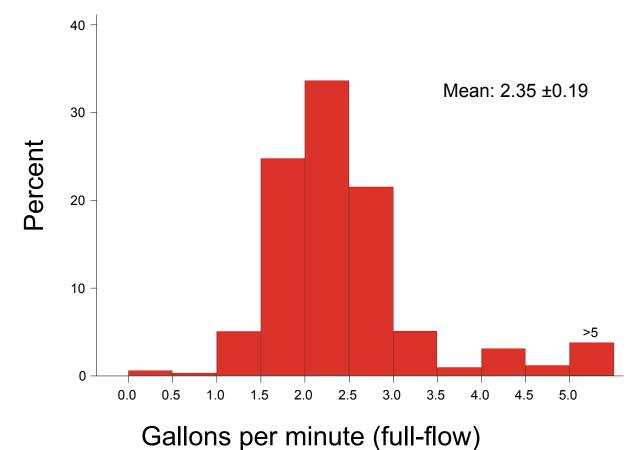
## Hot water delivery temperature



Hot-water temperature at kitchen sink (F)

For measurements in 299 apartments

## **Showerhead flow**

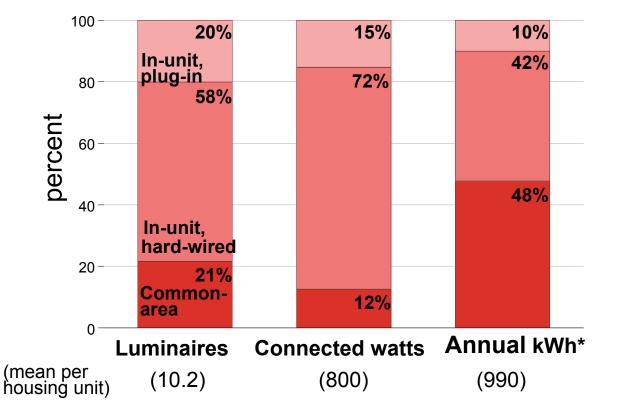


I X

For 331 measured showerheads

BUILDING CHARACTERISTICS LIGHTING

## Distribution of luminaires, watts and lighting energy



\*based on estimated operating hours

BUILDING CHARACTERISTICS

## Monitoring of in-unit lighting

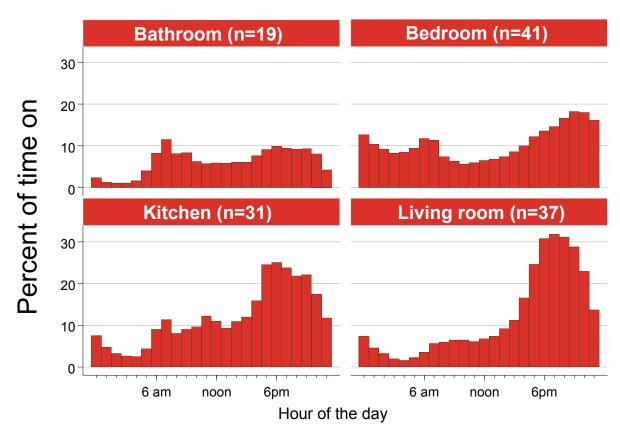
Туре	Location Number in Mean sample day of		Mean hou day oper		
Hard-wired fixture	Kitchen	31	2.8	±1.2	
	Bedroom	17	2.3	±1.1	
	Bathroom	19	1.5	±0.9	
Plug-in	Living room	35	2.6	±0.8	
	Bedroom*	23	1.8	±1.4	

**±** 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

BUILDING CHARACTERISTICS

## **Monitoring of in-unit lighting**



Combined results for hard-wired and plug-in luminaires

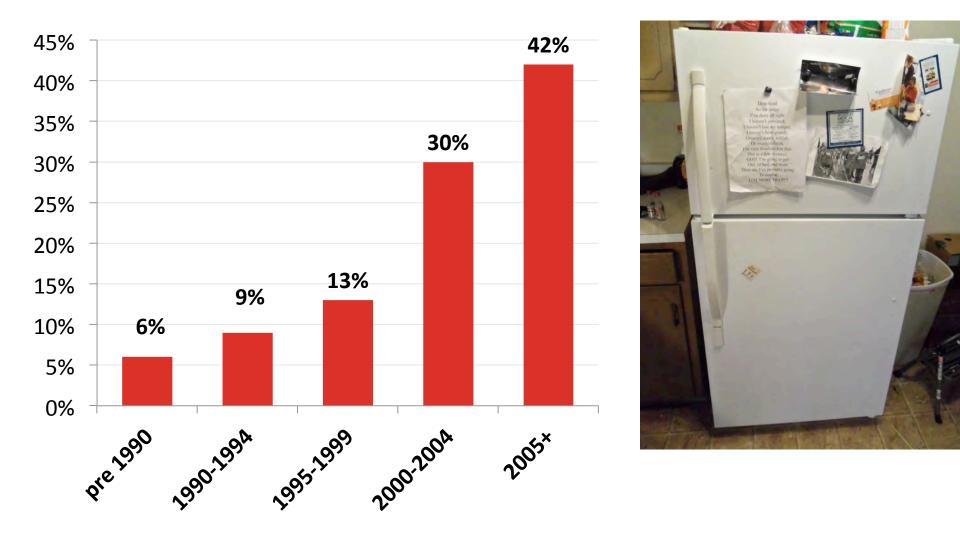
LIGHTING

**IN-UNIT REFRIGERATORS** 

BUILDING

**CHARACTERISTICS** 

## Age of refrigerators



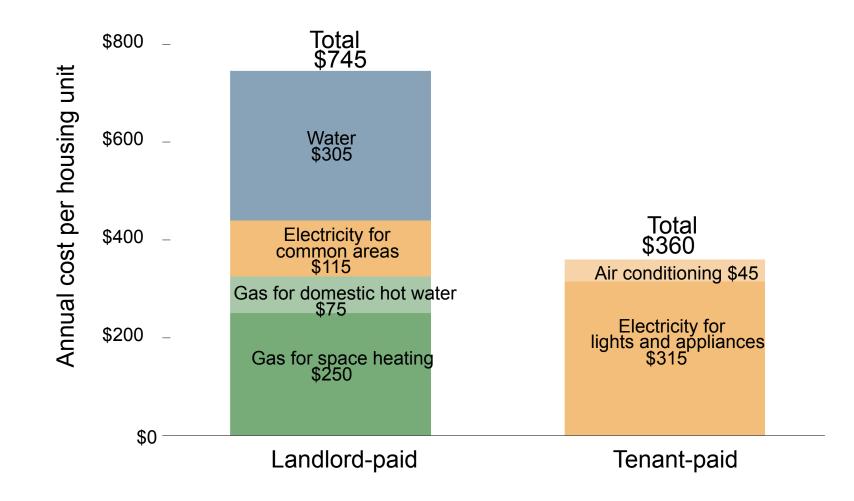
## Minnesota Multifamily Rental Characterization Study

# ENERGY EFFICIENCY OPPORTUNITIES

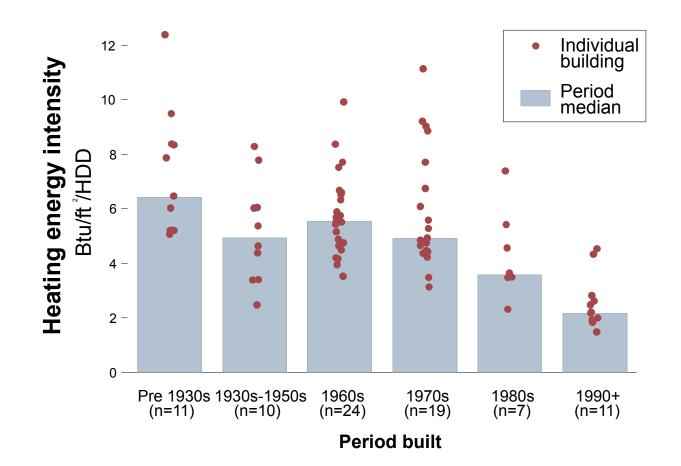
ENERGY EFFICIENCY OPPORTUNITIES

#### ENERGY OVERVIEW

## **Energy allocation**



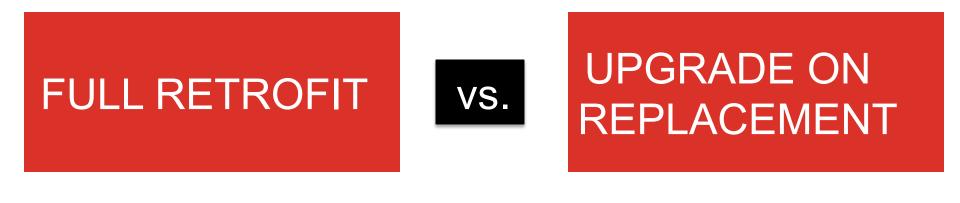
## Heating energy intensity



# **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**



## Median simple payback

In-unit lights: T-12 to T-8 fluorescent	(n=17)			32	2.0
Lighting controls: occupancy sensor (basement)	(n=71)			31.	0
Convert to indirect-fired water heating	(n=5)			28.5	
Window replacement	(n=43)		14.0		
Common lights: HID to LED exterior/garage	(n=83)		13.8		
High efficiency furnace	(n=8)		13.2		
Lighting controls: exterior photocell	(n=15)	•	12.7		
Programmable thermostat	(n=11)	11.	4		
Electric to gas clothes dryer	(n=5)	11.	D		
Energy Star refrigerator	(n=58)	9.7			
Energy Star sleeve/window AC	(n=91)	7.1			
Heating system tune-up	(n=27)	6.5			
High efficiency boiler	(n=75)	5.0			
Boiler vent damper	(n=67)	4.6			
Boiler reset control	(n=39)	4.6			
High-efficiency commercial-size water heater	(n=60)	4.5			
High-efficiency residential-size water heater	(n=8)	4.4			
Common lights: T-12 to T-8 fluorescent	(n=46)	3.4			
Exit light replacement	(n=12)	3.2			
Energy Star clothes washer	(n=100)	2.9			
Boiler pipe insulation	(n=53)	2.0			are treated as incremental
In-unit lights: Incandescent to CFL	(n=117)	0.9	upgrad	des at end of l	ife.
Low-flow showerhead	(n=99)	0.5			
Faucet aerator	(n=73)	0.2	Other	measures are	treated as retrofits.
Common lights: incandescent to CFL	(n=66)	0.1			
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		0 10	20	) 3	0

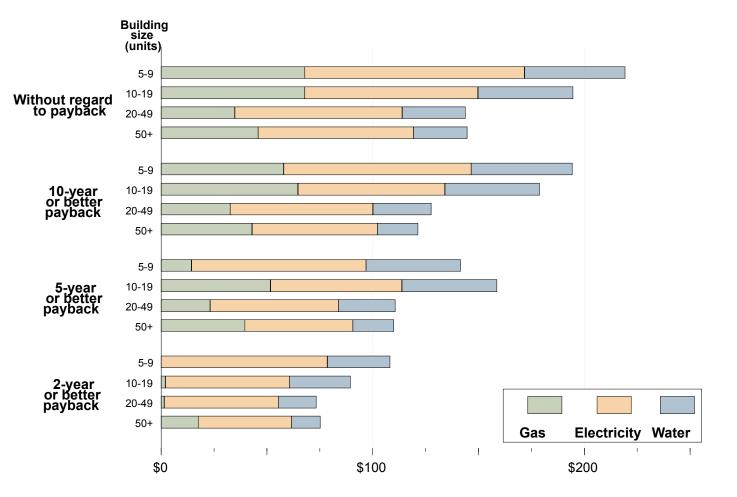
Median payback period (years)

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

ENERGY EFFICIENCY

**OPPORTUNITIES** 

## Annual savings per housing unit



#### Measure contribution to aggregate cost savings potential

In-unit lights: Incandescent to CFL	21%	23%	27%	42%
High efficiency boiler	14%	16%	12%	1%
Low-flow showerhead	13%	15%	17%	26%
Energy Star clothes washer	10%	9%	9%	0%
High-efficiency commercial-size water heater	8%	10%	9%	9%
Faucet aerator	6%	7%	8%	12%
Common lights: HID to LED exterior/garage	6%	2%	1%	0%
Boiler vent damper	5%	6%	5%	0%
Window replacement	4%	0%	0%	0%
Common lights: incandescent to CFL	3%	3%	4%	6%
Energy Star sleeve/window AC	2%	2%	0%	0%
All others	9%	8%	7%	4%
	Without regard to payback	10-year or better payback	5-year or better payback	2-year or better payback

ENERGY EFFICIENCY

**OPPORTUNITIES** 

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

#### MULTIFAMILY SPECIFIC ISSUE

## Landlord / tenant split

Landlord			Tenants	
Payback				
69%	No screen		31%	
68%	<10-year		32%	
66%	<5-year		34%	
49%	<2-year		51%	

#### Building size...

68%	5-9	32%
70%	10-19	30%
60%	20-49	40%
72%	50+	28%

#### Measure type...

92%	Heating/Cooling	8%
95%	Hot water	5%
14%	Lighting	86%
89%	Appliances	11%

# Minnesota Multifamily Rental Characterization Study

# TENANT / OWNER ATTITUDES







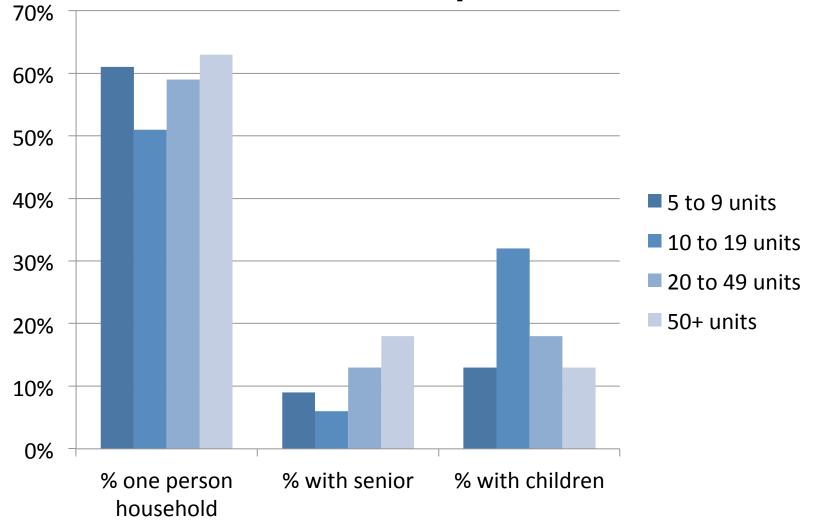


**DEMOGRAPHICS OF TENANTS** 

**TENANT / OWNER** 

**ATTITUDES** 

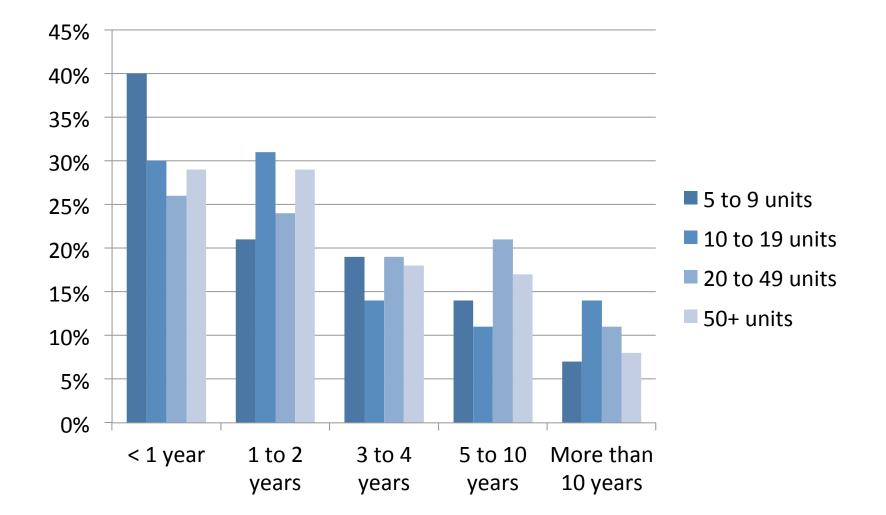
### **Household composition**



**TENANT / OWNER** 

**ATTITUDES** 

## Years in current unit

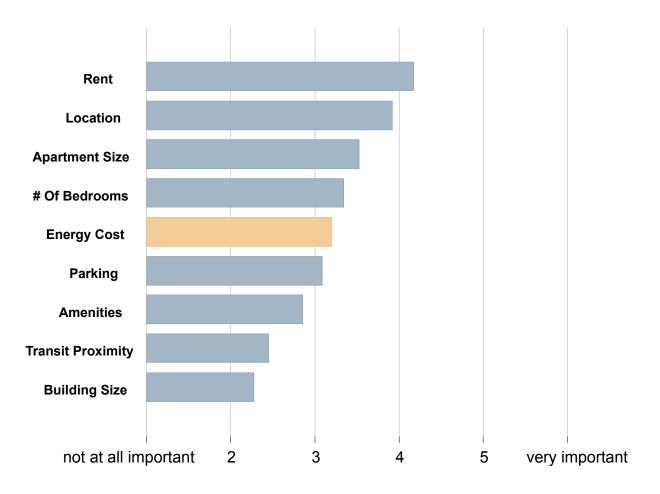


**TENANT SURVEY RESULTS** 

**TENANT / OWNER** 

**ATTITUDES** 

## Factors in deciding where to rent



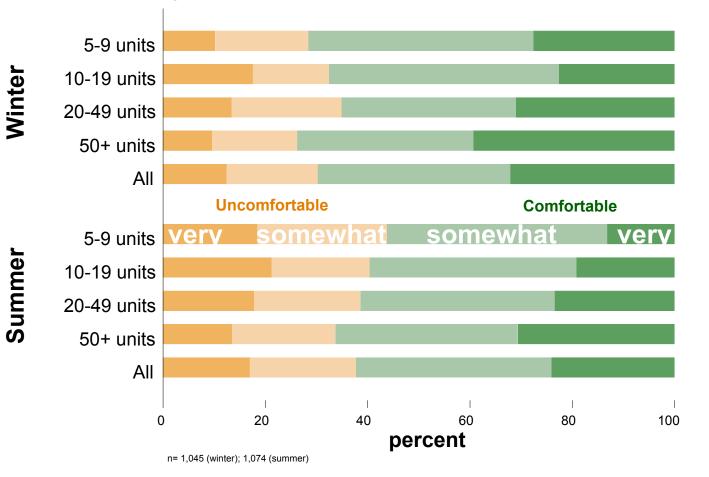
**TENANT SURVEY RESULTS** 

TENANT / OWNFR

**ATTITUDES** 

## **Comfort levels between summer and winter**

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

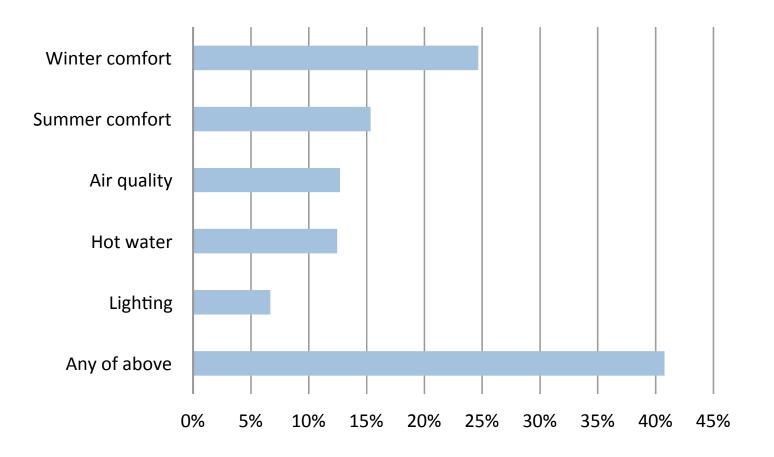


**OWNFR** 

TFNANT

**ATTITUDES** 

## Incidence of reporting comfort issue

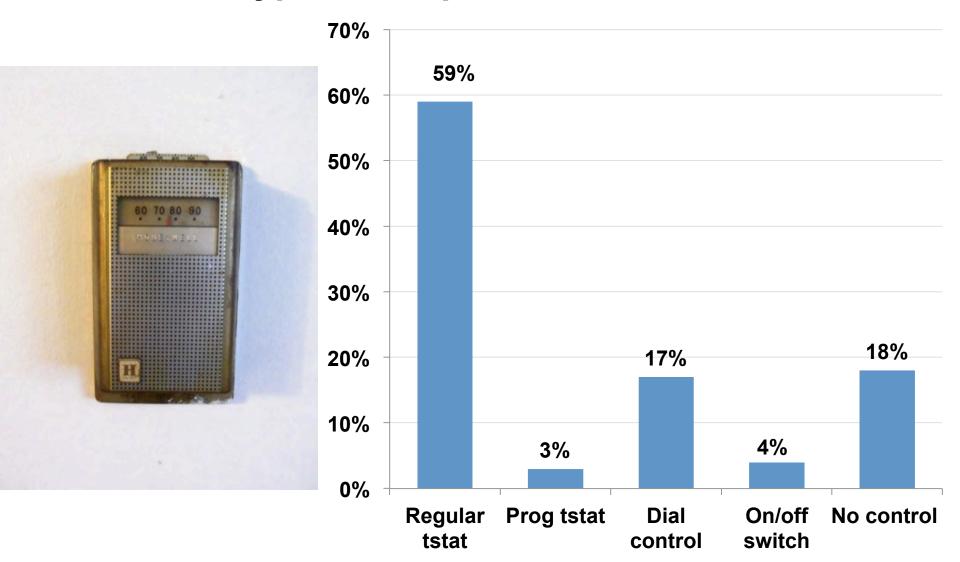


**TENANT SURVEY RESULTS** 

**TENANT / OWNER** 

**ATTITUDES** 

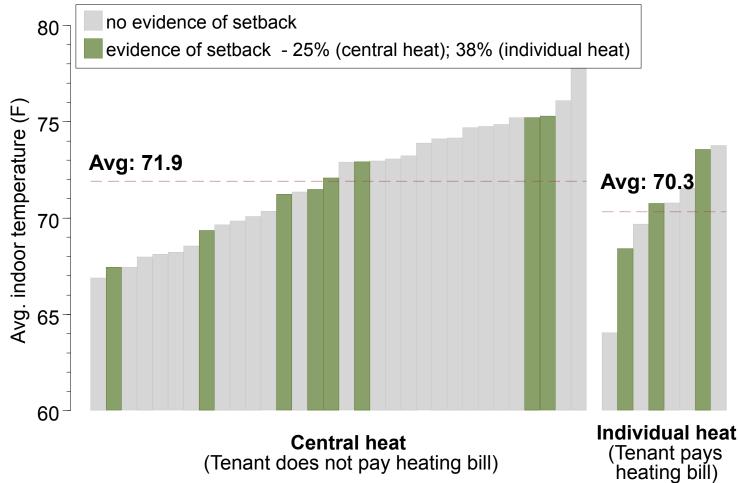
## **Type of temperature control**



TENANT / OWNER ATTITUDES

**TENANT SURVEY RESULTS** 

## **Evidence of setback**

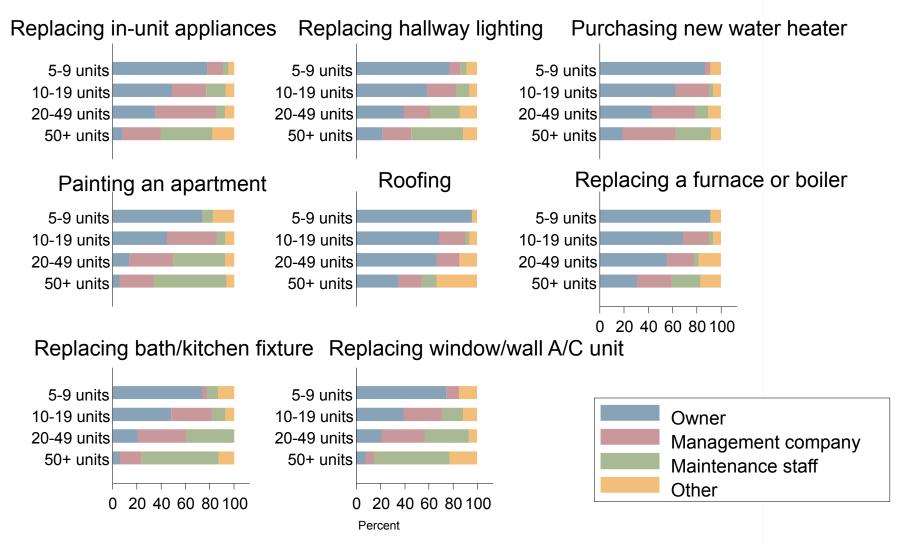


By apartment, sorted from lowest to highest temperature within heating type. Normalized to average Dec-Feb outdoor temperature

#### TENANT / OWNER ATTITUDES

#### **OWNER SURVEY RESULTS**

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

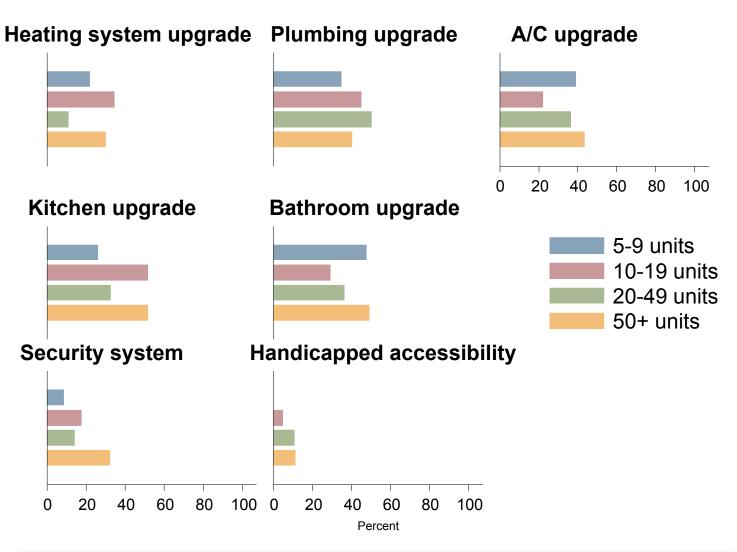


**OWNER SURVEY RESULTS** 

TFNANT / OWNFR

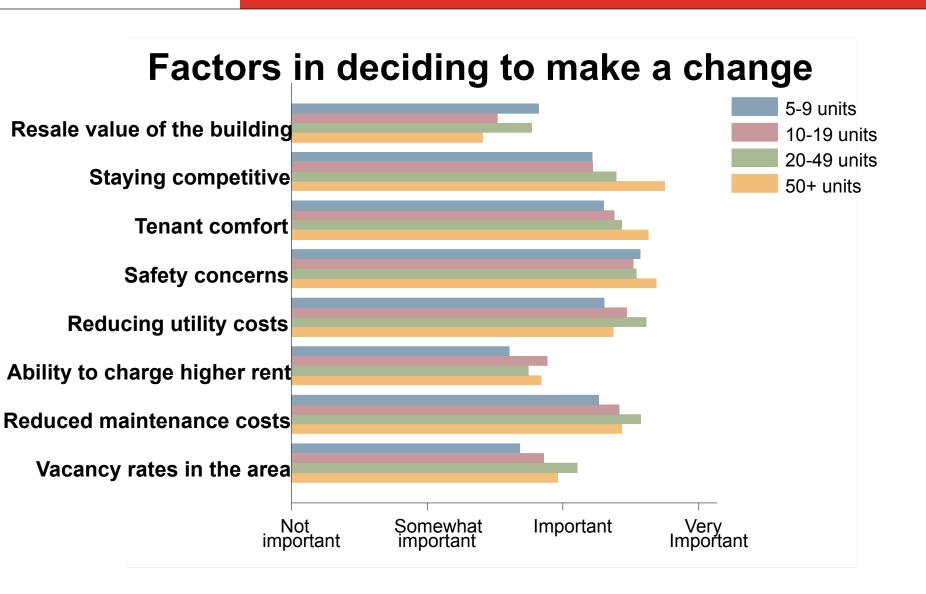
**ATTITUDES** 





TENANT / OWNER ATTITUDES

#### **OWNER SURVEY RESULTS**

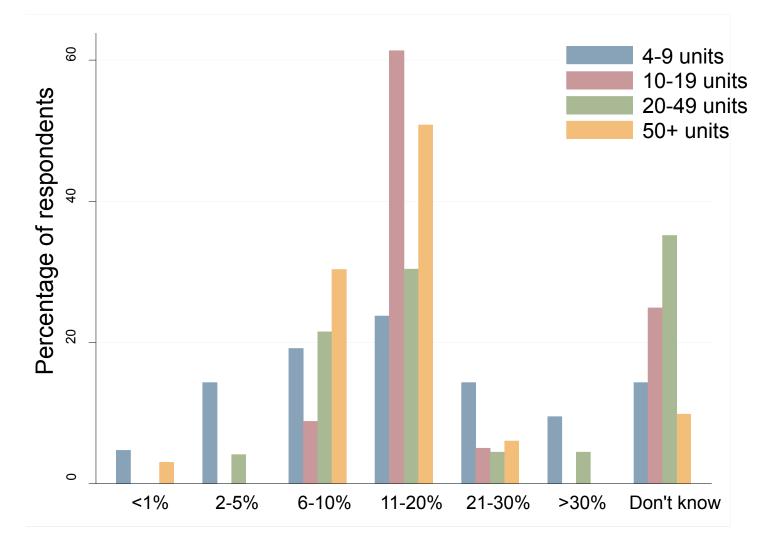


**OWNER SURVEY RESULTS** 

**TENANT / OWNER** 

**ATTITUDES** 

## Energy costs in relation to other costs



## Minnesota Multifamily Rental Characterization Study

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

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