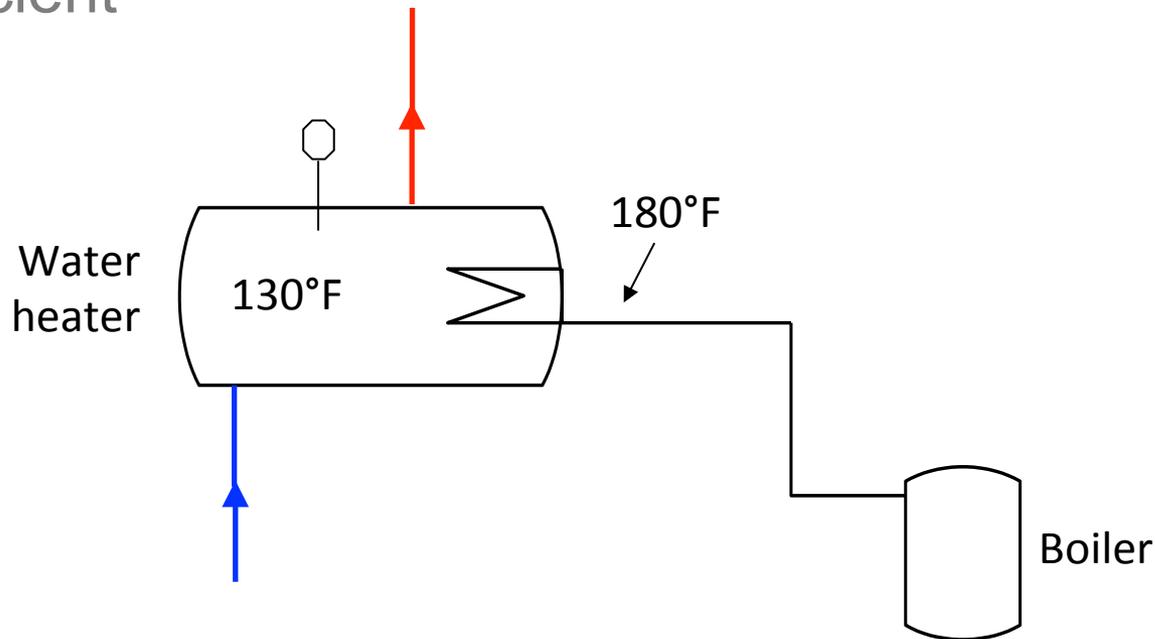


Domestic hot water can dictate return water temps

- Traditional coil-in tank requires high boiler temperatures, limiting boiler efficiency during DHW call
- Direct-fired condensing water heaters will be more efficient





Summary: getting condensing boilers to condense!

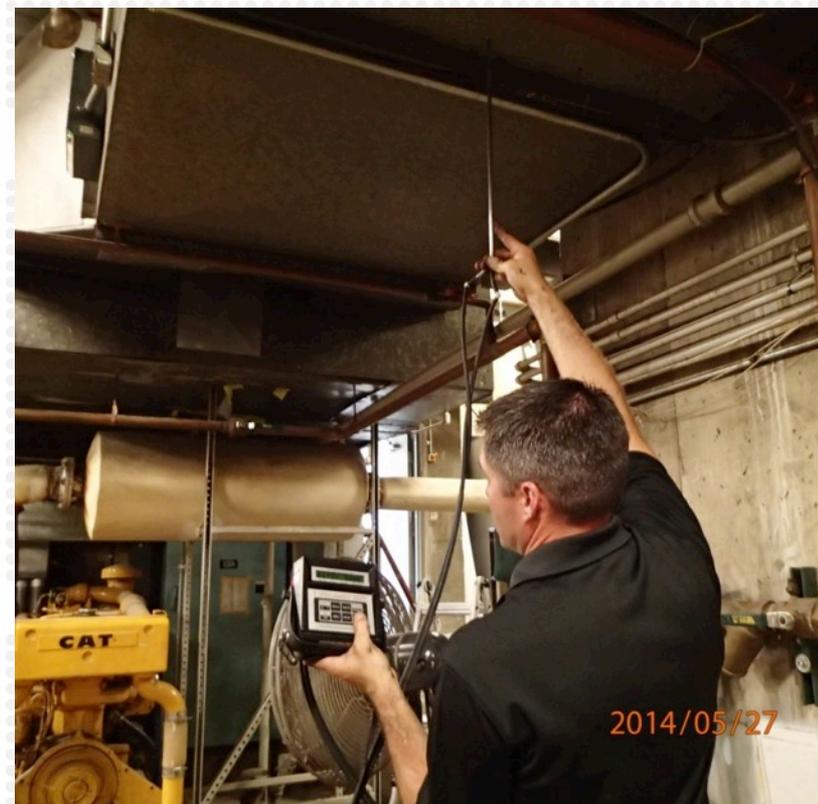
- Proper oxygen levels in flue gas contribute to optimal condensing conditions
- Maintaining aggressive control settings prolongs condensing capabilities
- VFD pump controls reduce pump speeds at part loads to optimize heat transfer
- Boiler room piping can dictate return water temps
- Choosing direct-fired condensing water heaters over indirect (sidearm) water heaters will maximize efficiency



More info on condensing boiler research

- Final report will be published this summer
 - 12 sites (Education, Office, Multifamily facilities)
 - Optimization improvements and energy savings analysis
- Webinar on April 3rd
 - Mncee.org/innovation-exchange

Optimizing ventilation systems



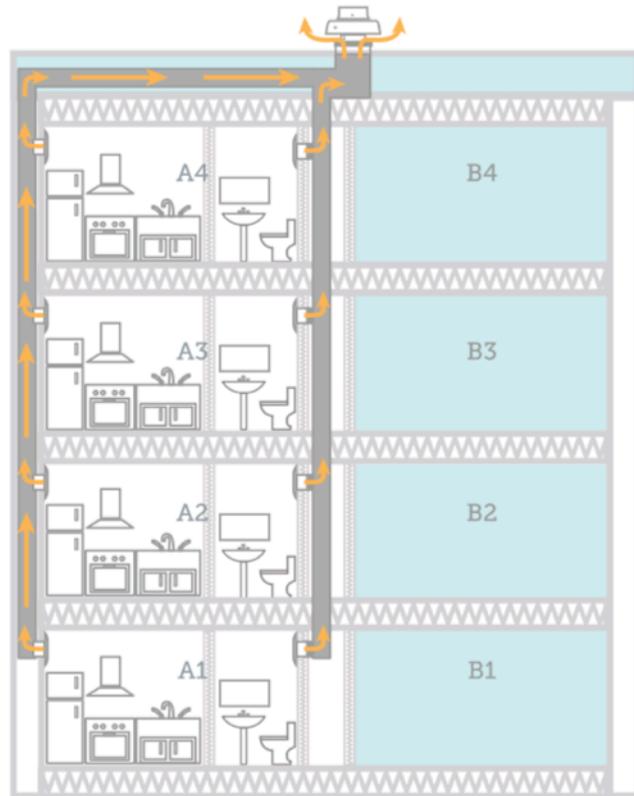
Optimizing ventilation systems

ISSUES

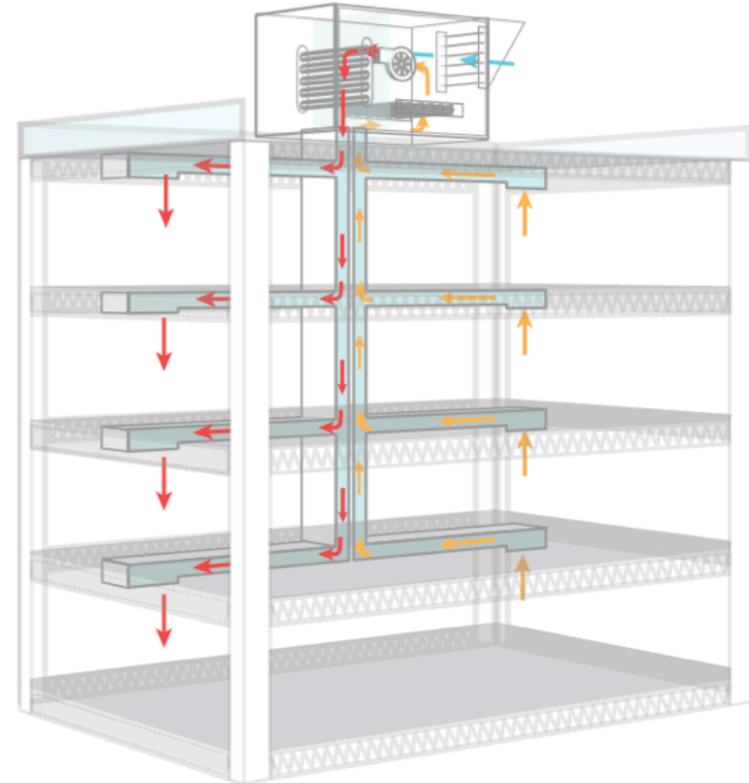
- High fan electricity use
- Excessive ventilation airflow
- Occupant complaints of drafts, odors
- Duct leakage
- Clogging and other flow balancing problems
- Difficult/costly to measure and quantify energy savings associated with retrofiting



Central ventilation systems



Central apartment exhaust



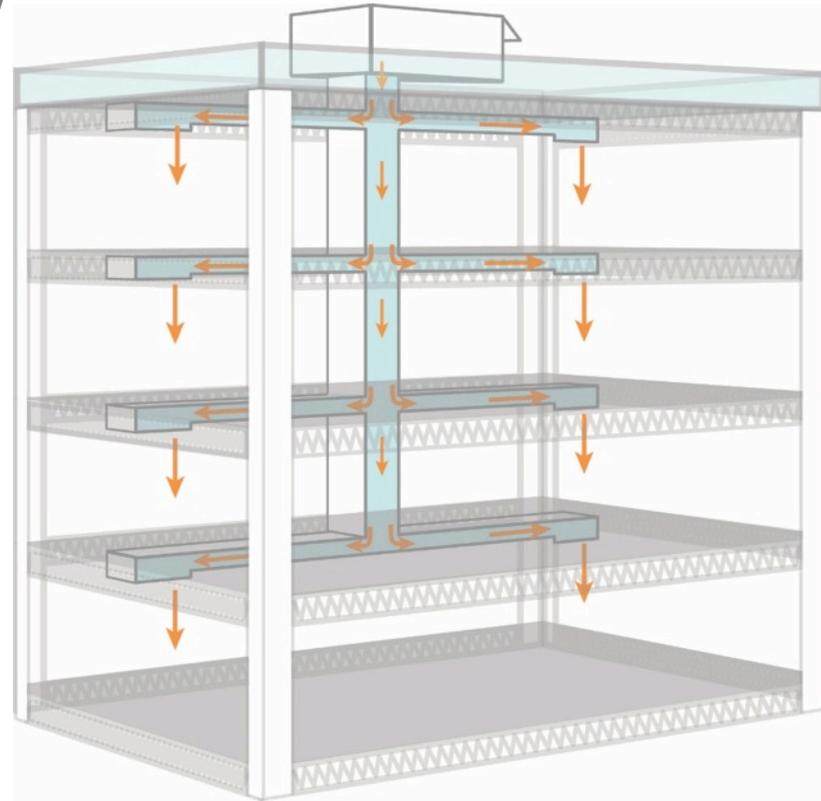
Central corridor/make up
air systems

Ventilation Improvements – corridor systems

- Reduce fan speed to provide code required ventilation flow

ISSUES

- Design flow rates were much higher than current required flow
- Faulty controls/sensors
- Flow rates not verified



Corridor ventilation retrofit in Minneapolis

Project: Re-sheave fan for lower flow

- 4,700 cfm reduced
- 9,611 therms saved
- 7,244 kWh saved
- \$6,899 annual savings
- <6 month payback

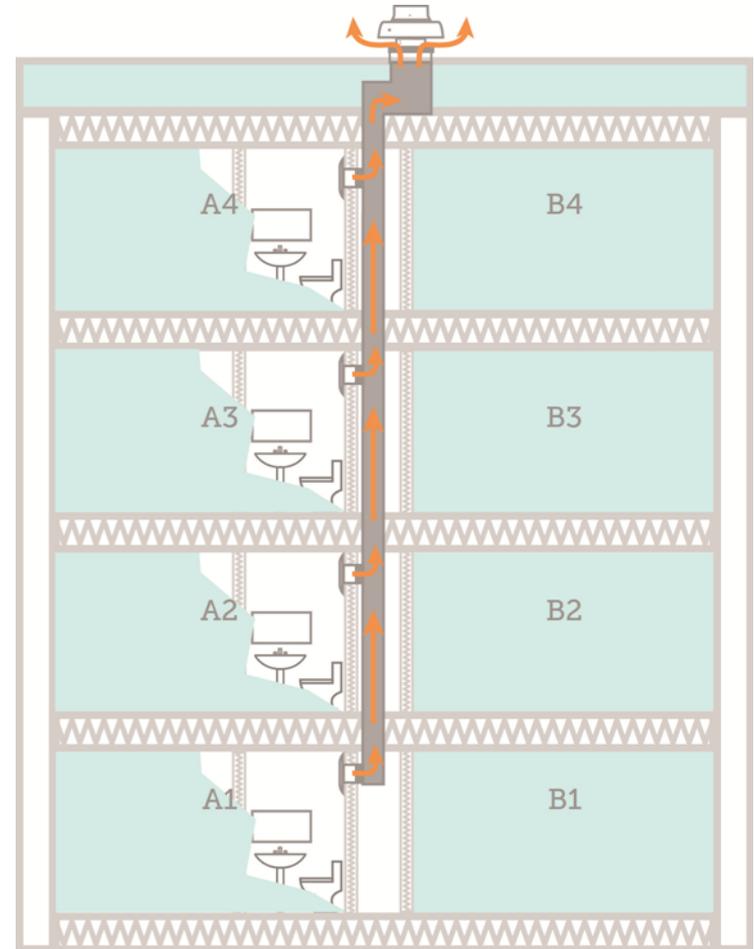


Ventilation Improvements – central apartment exhaust systems

- Reduce & balance flow
- Seal inlets, curbs & ducts
- Install high efficiency fans

ISSUES

- Design flow rates were much higher than current required flow
- Unbalanced flow
- Flows difficult to verify and seldom measured



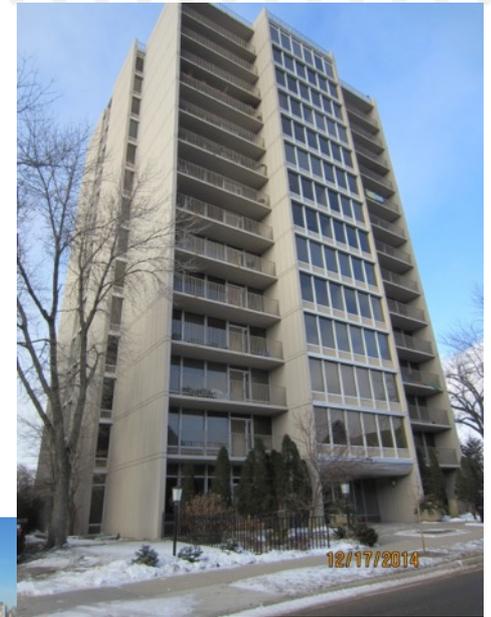
Central exhaust retrofit in Minneapolis

Project:

1- Replace operable balancing louvers with fixed orifices

2- Replace belt drive exhaust fans with high-efficiency type

- 2,299 cfm reduced
- 4,706 therms saved
- 21,979 kWh saved
- \$5,037 total savings
- 7 year payback
- Reduced odors and noise



Fixed balancing orifices balance inlet flow at low cost



1. Remove balancing devices prone to clogging or tampering



2. Seal duct leakage at inlet



3. Install fixed orifice sized for correct flow

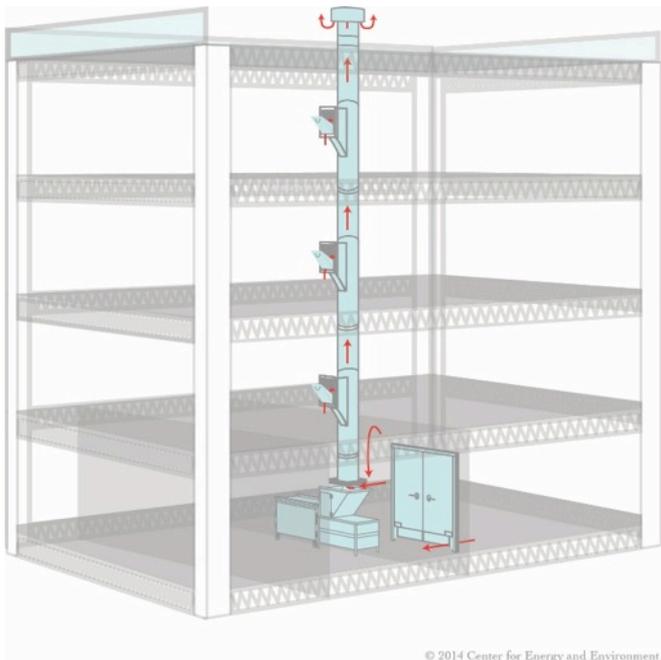
Replacing exhaust fans

1. Seal leakage below fans at curb
2. Replace with EC fans with adjustable speed controls
3. Verify flow is correct



• Trash chutes can affect ventilation performance

- Trash rooms may exhaust too much air
- Lack of air sealing can cause odor transfer
- Ventilation flow may be increased to compensate



© 2014 Center for Energy and Environment



Addressing the trash chute

- Keep trash room doors closed
- Seal trash room off from rest of building
- If no door, seal chute to compactor/trash bin
- Reduce trash room exhaust fan flow rate
- Reduce chute cap opening



**\$1,500 savings annually
from reduced stack flow**





More info

- *Multifamily Ventilation Assessment & Retrofit Guide* available now
 - Guide for assessment and retrofitting central supply and exhaust systems (and trash chutes)
 - Audience: HVAC contractors and energy consultants
- Project report this summer
 - Energy savings opportunities found in 18 buildings
 - Retrofit outcomes on 6 buildings

Controlling hot water recirculation loops



Hot water recirculation loops

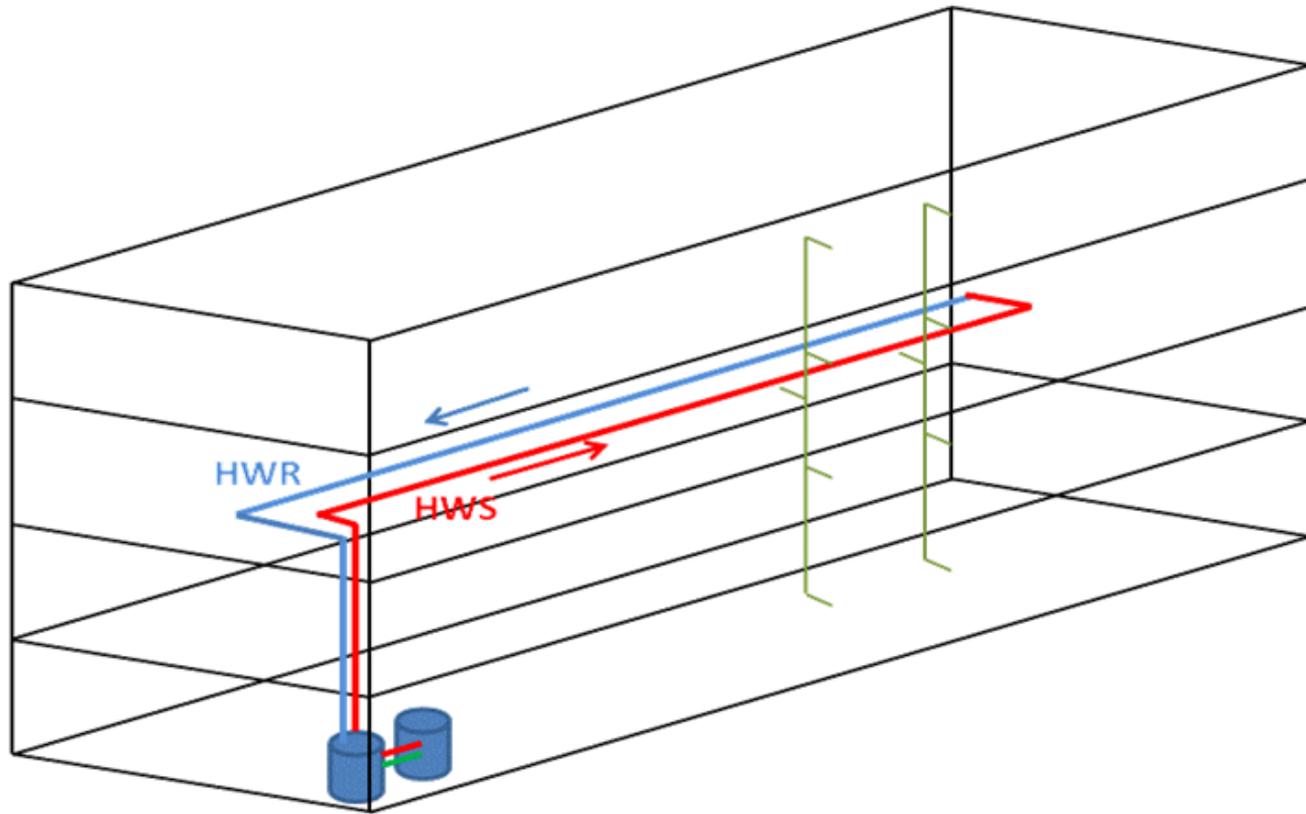


Image source: HMG, Inc

DHW energy losses

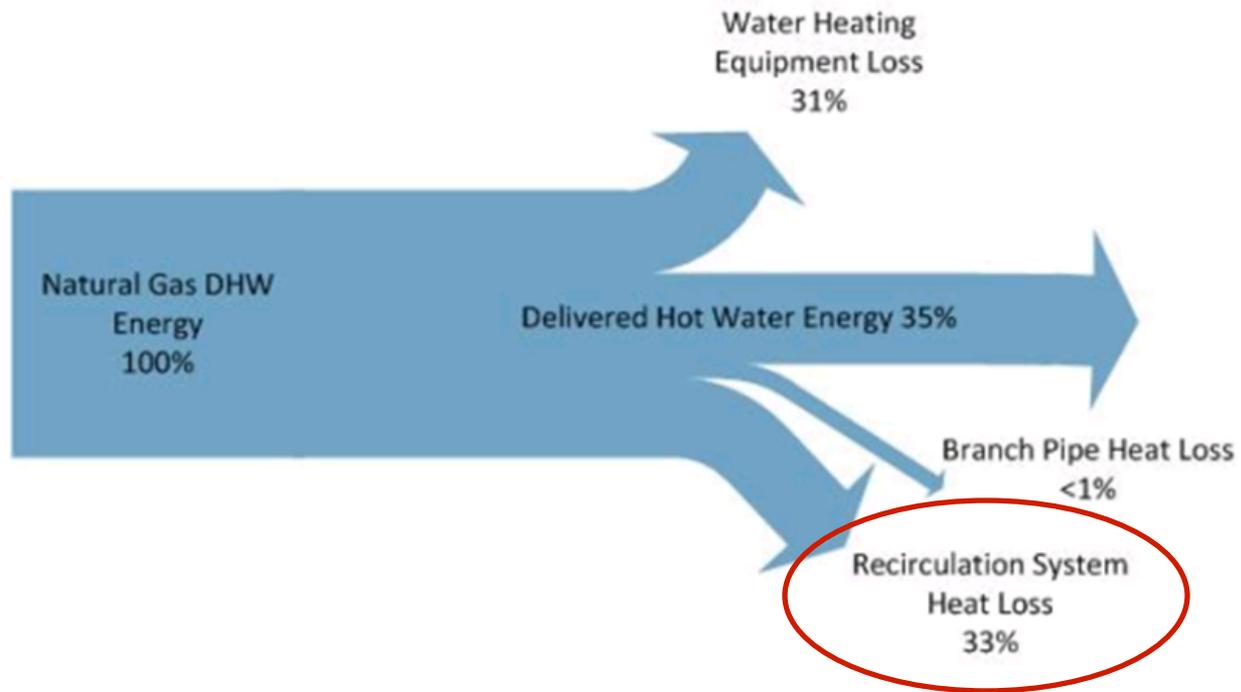


Image source: HMG, Inc. Multifamily Central Domestic Hot Water Distribution systems. 2013

• Enovative's Demand Controller

- Control stops pump when
 - no building demand
 - or*
 - the recirculation loop temp is above 100F
- Pump run time reduced from 24/7 to average 14 mins / day
(ARIES Collaborative/Building America study in 2014)

A good investment...

- Has aggressive energy paybacks
- Lowers O & M costs
- Improves building comfort
- Makes things easier for staff
- Is “tried and true”
- Is easy to implement

Variables that affect savings

- Proper Installation
- Insulation on recirc loop pipes
- Seasonal consumption
- Incoming cold water temp
- Building consumption habits
- “Crossover”

DHW Savings
Range: 5-15%
Average: 9%



• • Rochester installation

- 3-story
- 39 unit building
- Built in 1955
- Failed water heaters
- Shower heads and faucet aerators installed along with building assessment



10% DHW savings from Demand Controller
Payback = 4 years
540 therms saved, 14 therms / unit

Aerosol envelope air sealing



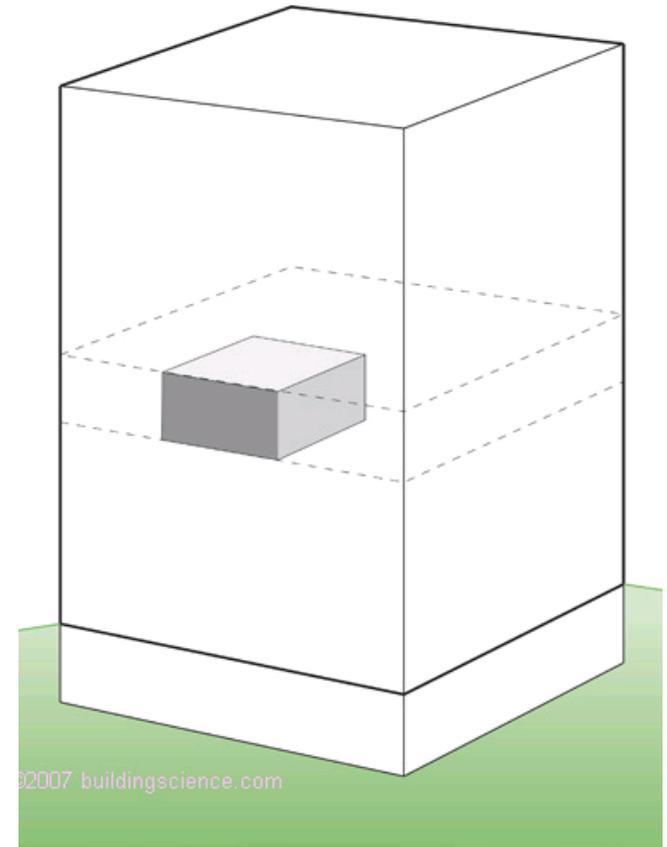
Concept:

- Pressurize apartment unit
- Spray air sealing fog
- Sealant particles build up on gaps as they exit the envelope

• Multifamily compartmentalization

Creating an interior air barrier around each unit

- Reduced stack effect
- Reduced noise transfer
- Reduced odor transfer/improved IAQ
- Increased comfort
- Increased energy efficiency





Video

• Nuts and bolts

PREP WORK

- Horizontal surfaces covered
- Windows, exterior doors covered
- Finished floor covered (ideal before flooring is installed)
- Door handles covered
- Plumbing fixtures covered
- Ceiling fans covered
- Radiators covered
- Sprinkler head openings covered
- Remove outlet/switch plates



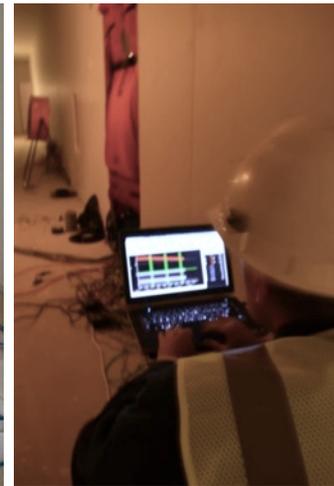
• Nuts and bolts

SET UP/SEAL

- Blower door and nozzles
- 100Pa pressurization
- ~ 90% RH maintained

CLEAN UP

- Open windows, purge
- Remove masking



New Construction Results

18 units in 3 buildings

- Typical air leakage reduction
 - 0.56 ACH50
 - Passive house 0.6 ACH50
- 78% to 95% tighter than code
 - 3.0 ACH50 max. required by code
 - 2015 Residential Energy Code
- 90% tighter than Energy Star high rise requirement for multifamily

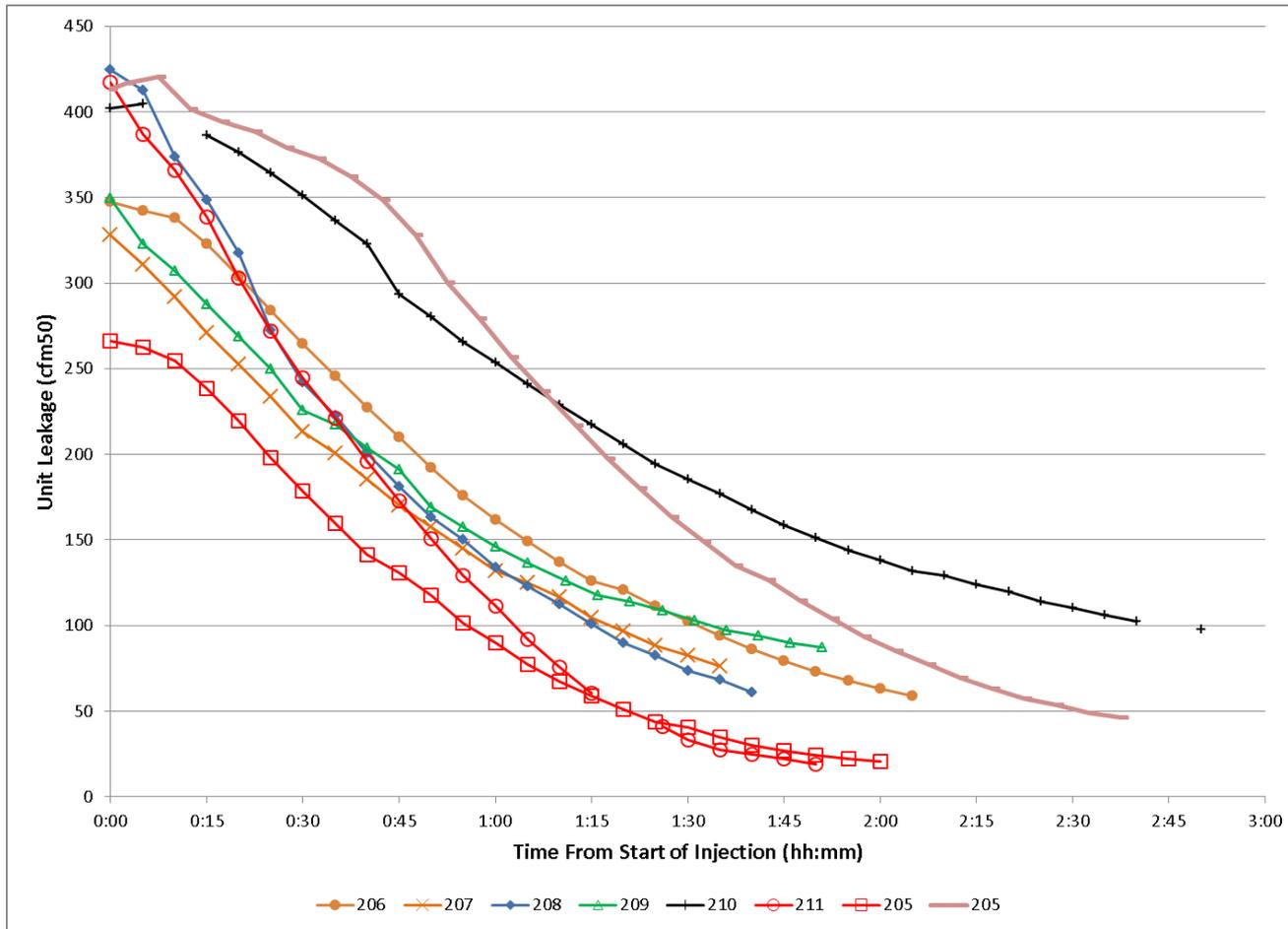


Existing building results

- 9 units in 2 buildings
- Typical air leakage reduction 4.76 ACH50
- Avg leakage reduced:
 - 691 CFM50
 - 68% reduction



Leakage reduced over injection period



Sealed penetrations



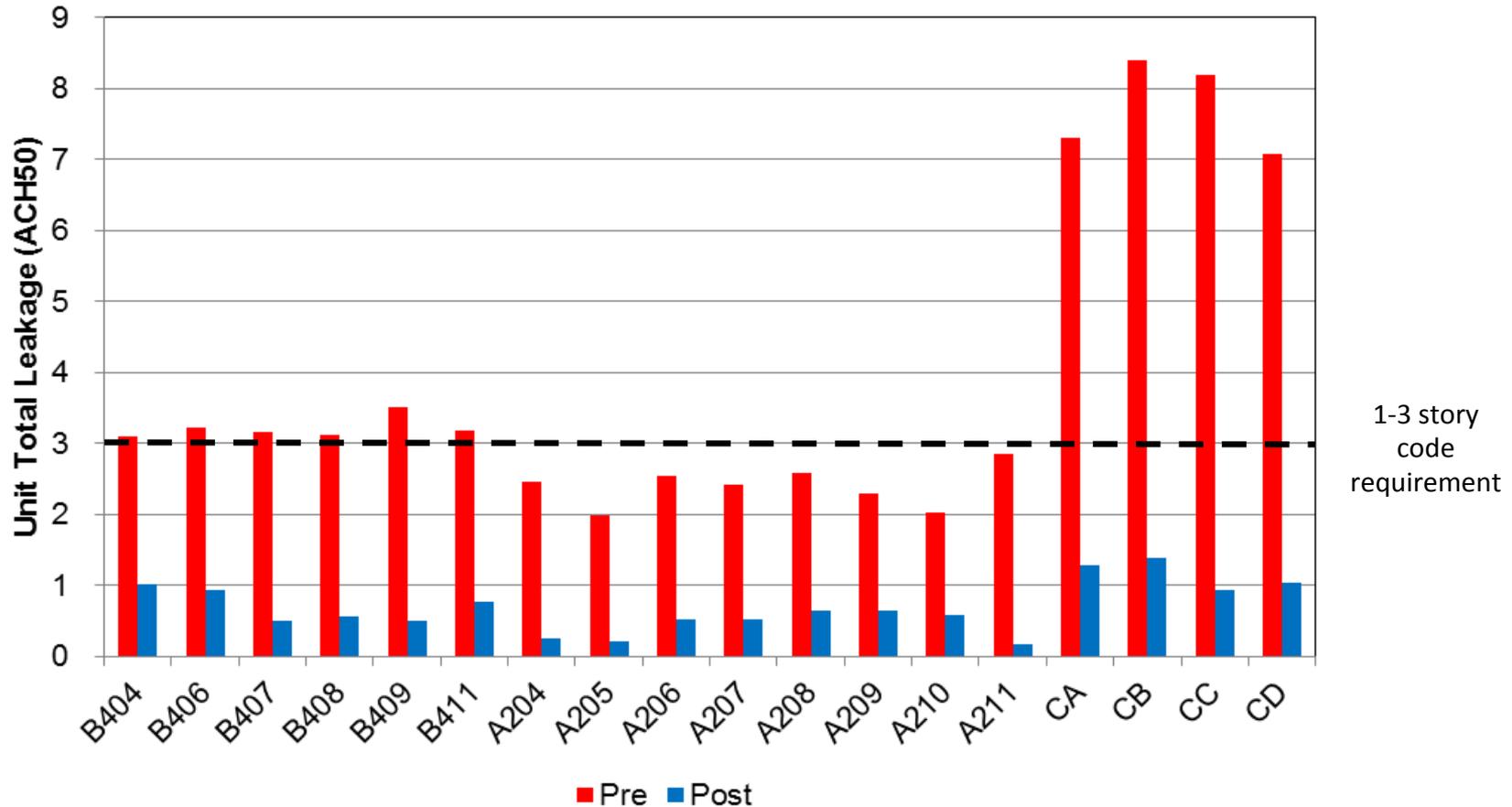
Sealed penetrations



Sealed wall/floor joint

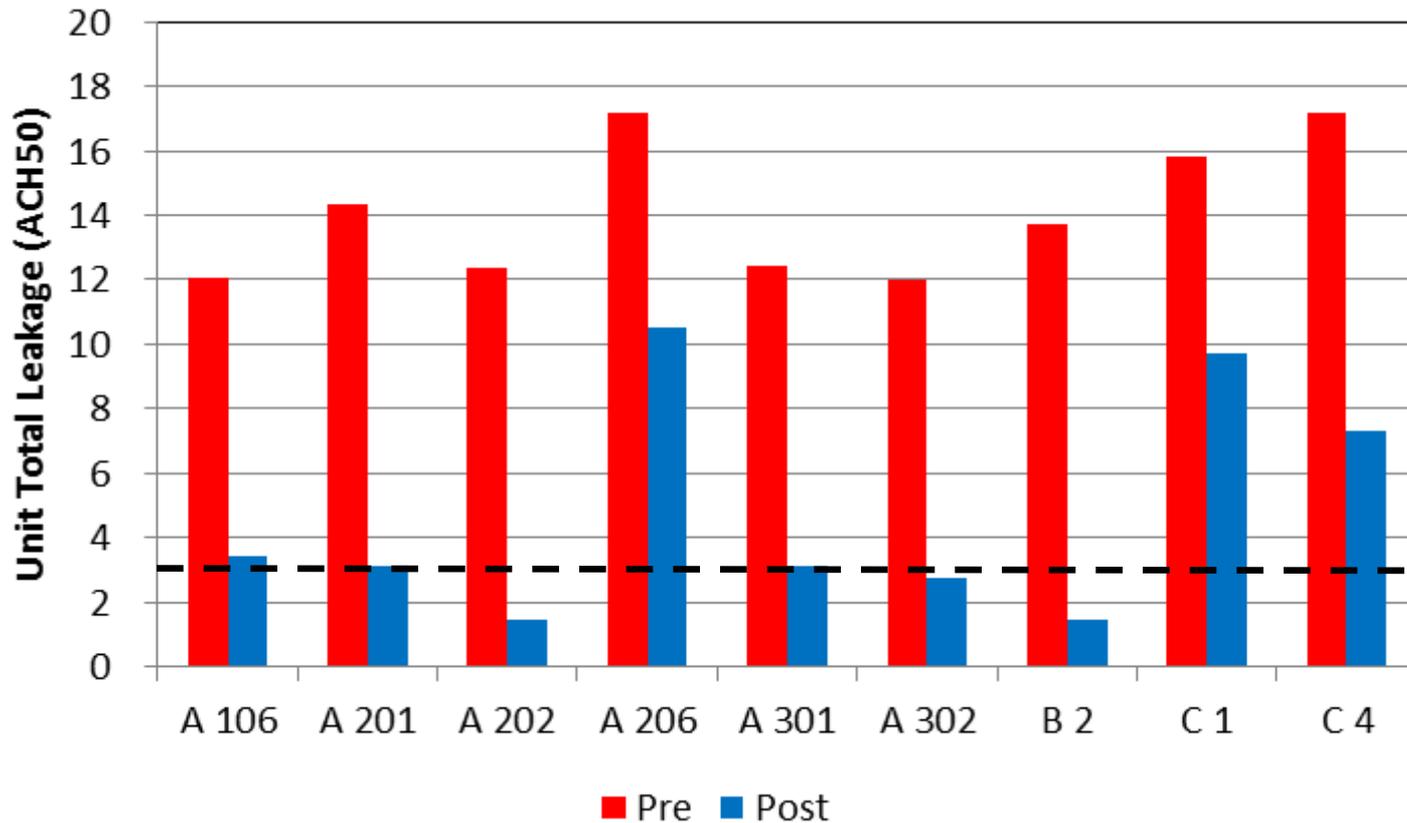


Leakage Results: 18 New Construction Units



Average leakage: pre= 3.9 ACH50, post= 0.7 ACH50
 54% to 95% below code requirement, average= 77%

Leakage Results: 9 Existing Units



1-3 story
code
requirement

Average leakage: pre= 14.1 ACH50, post= 4.8 ACH50
6 of 9 within 15% of new construction code requirement



Identifying the opportunity

IDEAL CANDIDATES

- Moderate rehabs “floors and cabinets”
- New construction

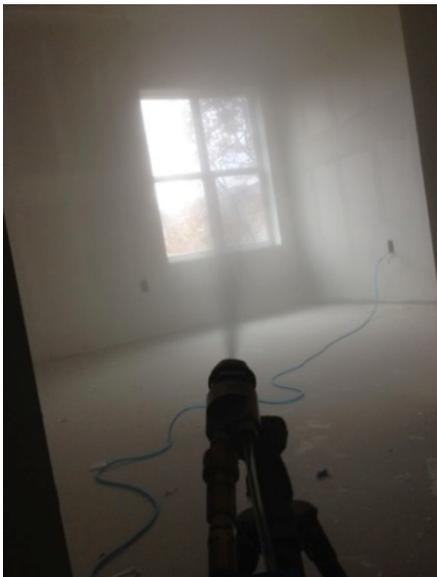
NOT IDEAL

- Where carpet is installed
- If occupied

• Air sealing at lower cost?

Aerosol

- Prep
- Sealing process
- Simultaneous air leakage testing ensures results



Manual air sealing

i.e. caulking/foaming

- Architectural specification
- Labor
- Air leakage test

=> Uncertain results



Vs.

Marketable?

BENEFITS

- Reduced mid and high range noise transfer
- Reduced odor transfer
- Improved comfort
- Simultaneous air leakage testing ensures results
- Expedited process, labor savings potential

CONSIDERATIONS

- Cost
- Not a solution for large air leak gaps
- Rehab or new construction only
- Balanced ventilation is crucial

A good investment...

- Has aggressive energy paybacks
- Lowers O & M costs
- Improves building comfort
- Makes things easier for staff
- Is “tried and true”
- Is easy to implement



Stay tuned for more info (Jan 2017)

Study will look at :

- 6 test sites; Rehabs and new construction in MN
- Enabling commercialization of process
- Air leakage reductions
- Sound attenuation
- ID leak site locations with fluorescent dye/black light photography
- Evaluation of time and materials required

More info CEE programs and research: mncee.org



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THANK
you!

Questions?

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