Steam System Balancing and Tuning

Building America Stakeholder Meeting

Austin, TX

Jayne Choi, Energy Analyst, CNT Energy

March 2, 2012

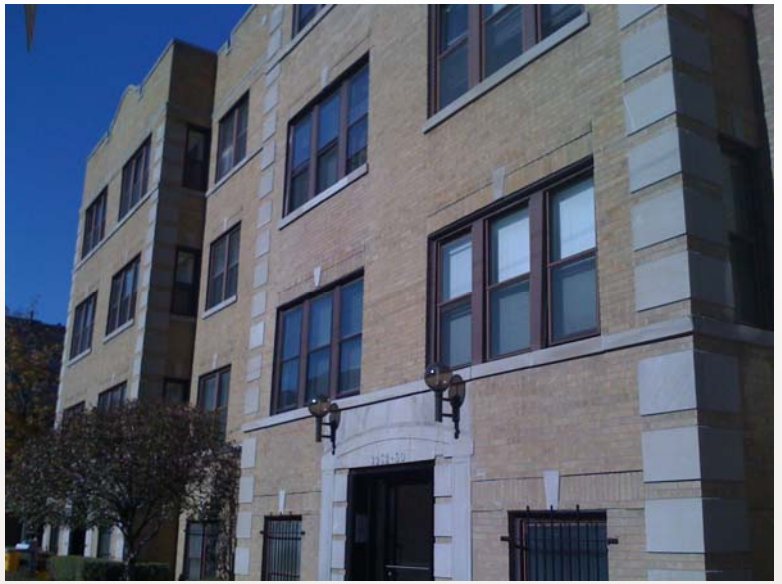
PARR

- Current collaboration with GTI as a part of the PARR Building America team
  - Steam Systems Balancing and Tuning Study
  - Heating season 2011-2012

Problem Statement

Background

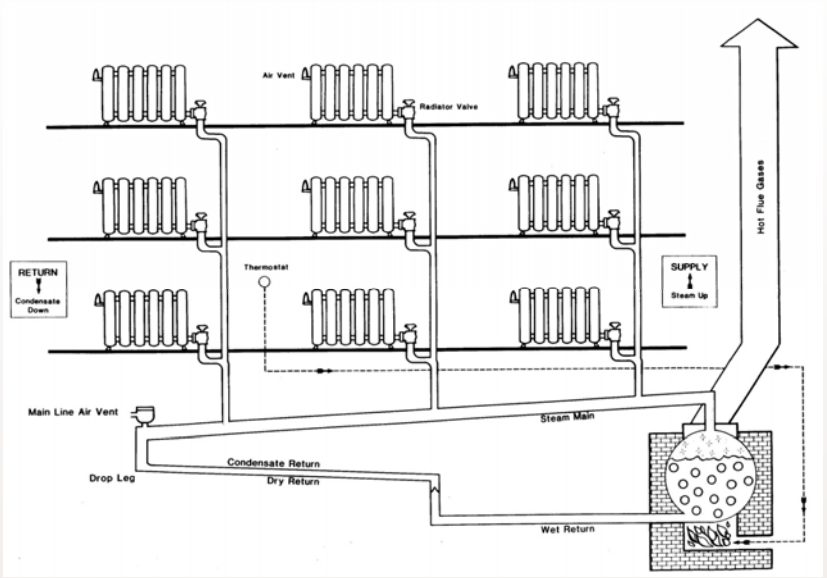
- In Chicago, heating is the focus of residential energy use
- Of the 470,000 multifamily units in the Chicago region, at least 70,000 of those are steam heated
- Old steam systems invariably suffer from imbalance
  - Tenants must use supplemental heat or open their windows to cool their apartments during the heating season
- Buildings are often overheated



(CNT Energy)

Steam Heating

- Steam heat was the best option for buildings constructed between 1900 and 1930
- Boiler cycle of single pipe steam systems
- Systems have been upgraded from coal to natural gas and many have undergone boiler replacement, but distribution systems remain largely the same
- Not designed for efficiency



(Peterson, 1985)

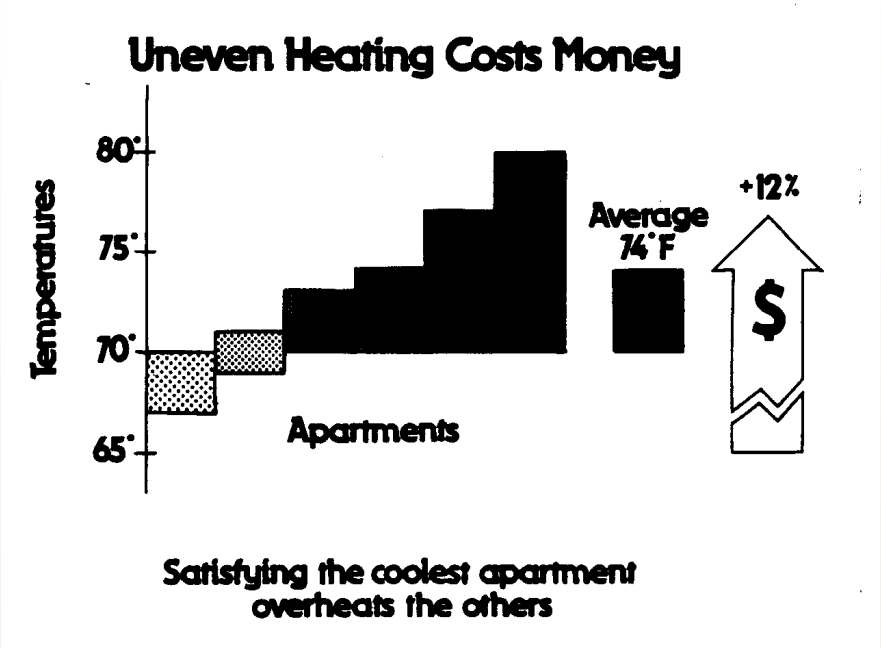
Problem Statement

Problem Statement

Background

- Contractors currently not commonly selling system balancing as a service or recommending it as a measure
- Not tangible – often just requires time and dedication rather than expensive equipment replacements
- Difficult to convince owners of its value
  - Balancing is a separate issue from boiler replacement
  - Natural gas is cheap, so it is not worth the time or effort

Problem Statement



(Peterson, G., 1985)

Cost-effectiveness

- Improving the balance of buildings provides
  - Opportunity for cost savings
  - Previous studies: 5-15% energy savings, 2-5 year payback
  - Increased resident comfort

Research Questions

- How do steam balancing measures affect the temperature dynamics within units?
- Will steam balancing affect the average length of boiler cycles?
- How cost-effective are steam balancing measures?

Technical Approach

- Steam balancing measures
  - Replacing radiator vents
  - Adding or upgrading main line air venting
  - Boiler controls (4-6 sensors, indoor averaging)

Technical Approach

Install steam balancing measures in 10 test buildings:

- Single-pipe steam
- 15-30 units
- Uneven heating throughout the building (based on observations from auditor, building manager, and/or tenants)
- Boiler in good condition

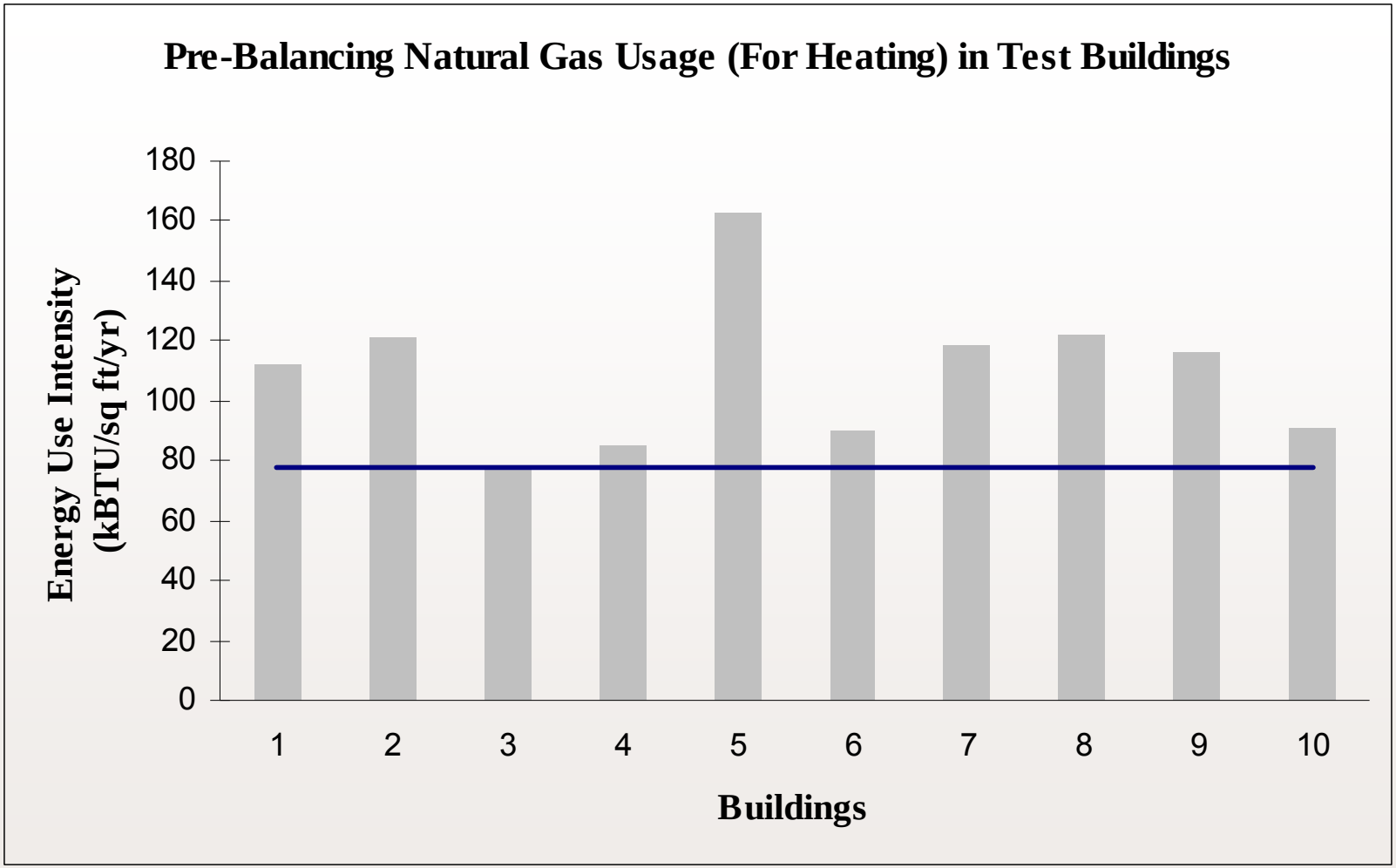
Energy Savers Program

A single point of contact to provide multifamily building owners with access to:

- **Technical Assistance**
  - Utility bill analysis
  - Energy assessment
  - Cost-effective energy-saving recommendations
- **Financing**
  - Low-cost financing through our partner, the Community Investment Corporation
- **Construction Oversight**
- **Annual Performance Monitoring**
  - Two years post-retrofit

energy savers
A one-stop energy efficiency shop for multifamily building owners

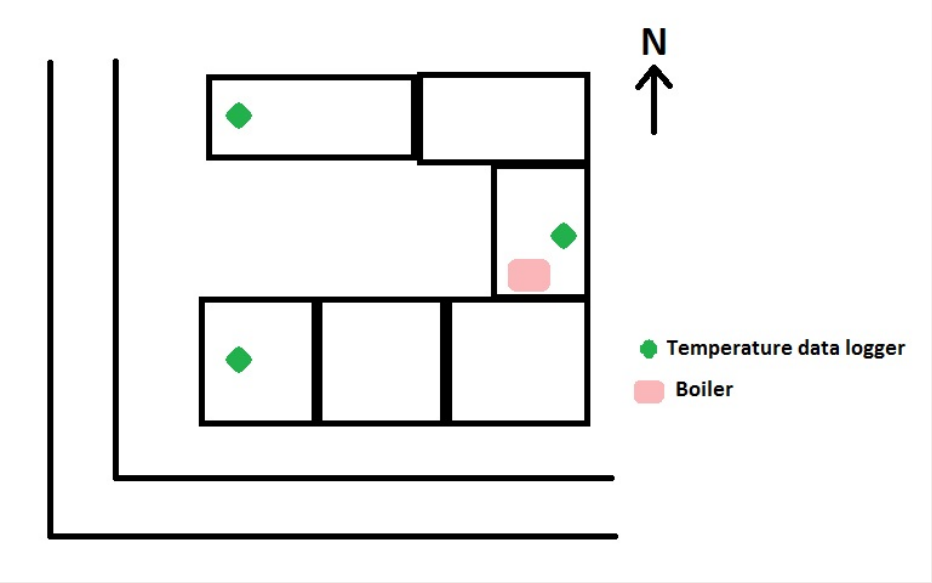
Technical Approach



(Data has been weather-normalized)

Technical Approach

- Retrieve pre-upgrade measurements and data for monitoring
  - Structural data
  - Boiler information/pipe structure/condition of vents/type of existing controls
  - Temperature data from units
  - Boiler run-time data
  - Tenant survey/heat calls
- Develop detailed scopes for steam balancing work to be done
  - Measures included replacing radiator vents, adding or upgrading mainline air vents, and installing boiler controls
  - Scopes included price breakdowns for each measure



Technical Approach

- Oversee general contracting
  - Inspection of work/quality control
  - Boiler control settings
- Collect post-upgrade data
  - Temperature data from units
  - Boiler run-time data
  - Tenant survey/heat calls
- Utility bill analysis comparing pre-upgrade and post-upgrade heating fuel use
  - Weather-normalized calculation of heating Energy Use Intensity (kBTU/sq ft/yr)

(http://www.onsetcomp.com/products/data-loggers/u10-003)

Project Status

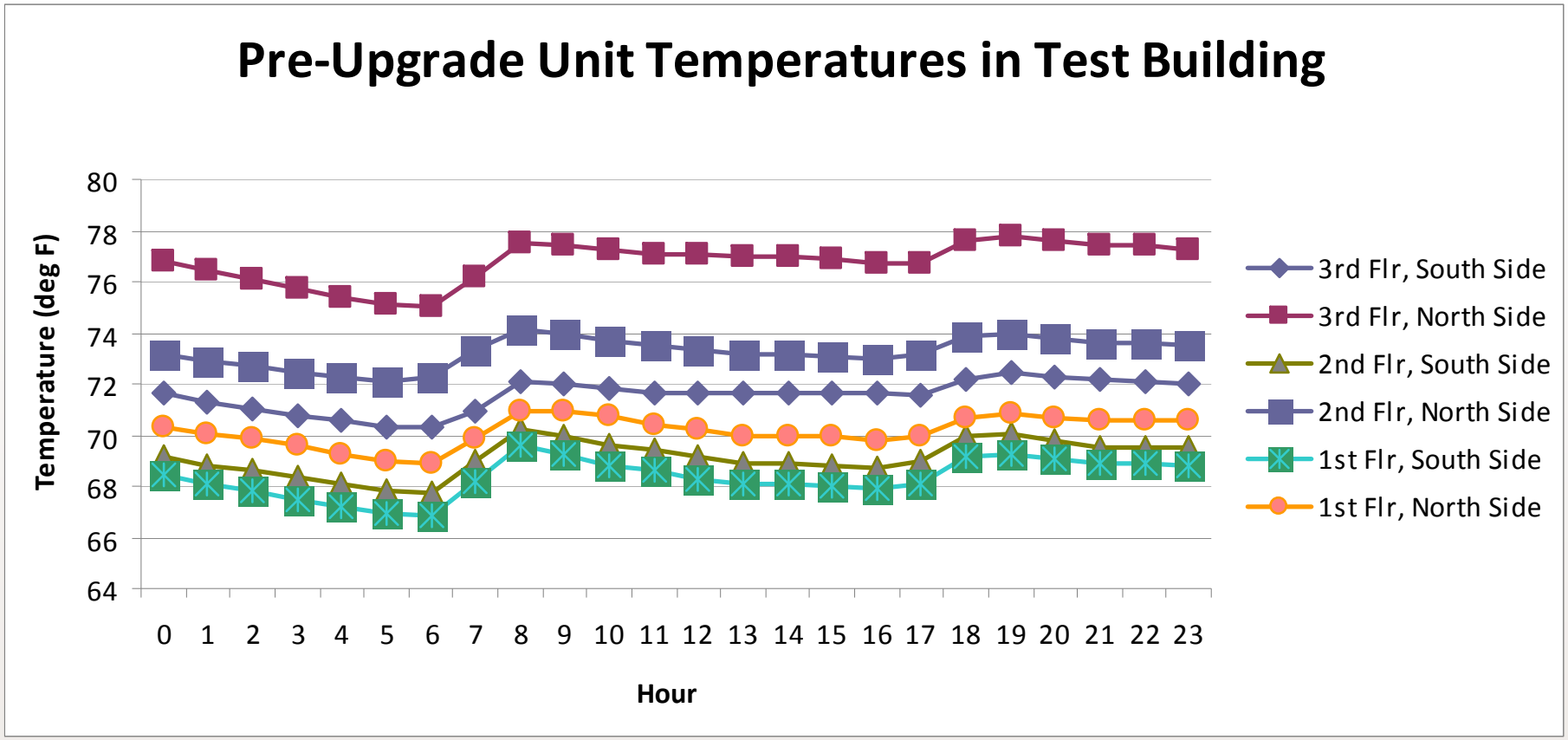
- Pre-upgrade measurements and data collected
- Steam balancing measures installed in test buildings
- Pre-upgrade data being analyzed
- Post-upgrade data collected (in process)

Analysis

Temperature control and steam systems behavior (pre and post-measure comparisons):

- Data from temperature loggers used to determine temperature distribution in building
- Temperature and boiler firing data used to determine average time for units to heat up
- Boiler run-time data shows the average length of boiler cycles
- Tenant comfort survey

Pre-Measure Data



Analysis

Cost-effectiveness

- Average cost of balancing (radiator vents, mainline vents, boiler controls)
- Natural gas savings
  - Determined from boiler run-time data and utility bill analysis
- Natural gas savings converted to financial savings
- Calculation of simple paybacks from financial savings and measure costs

Analysis

- **Measure Costs**

	Main line vents	Radiator vents	Boiler controls
Average cost*	$1,800	$3,700	$5,100

* Averages of measure costs from 10 test buildings

Summary

- **Project seeks to**
  - Determine the cost-effectiveness of steam balancing measures
  - Develop steam balancing as a viable energy efficiency measure
  - Provide guidelines to deal with some of the current barriers associated with steam balancing systems

Questions?

Thank you!

Jayne Choi

Energy Analyst

CNT Energy, Chicago, IL

jchoi@cntenergy.org