Appendix B:
Case studies of efficiency measures

Case study: Thermostatic radiator steam traps and thermostatic steam trap replacements

This study concerns an 88-unit building on the Upper West Side, New York, NY. The heating system contractor replaced 436 thermostatic radiator steam traps (installed on the outlet of each apartment radiator) and 65 float and thermostatic steam traps (installed at the base of the steam supply risers due to low pressure riser).

The 436 thermostatic radiator steam traps and the 65 float and thermostatic steam traps cost:
$77,000

The building also replaced the vacuum return unit for:
$25,000

The building managing agent reported 30–35% less fuel consumption from the previous year.

This is a significant decrease in fuel consumption and the project will pay for itself in about five years.

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Case study: Energy management system (EMS)

An ENERGUARD™ EMS system was installed in a 322-unit building in the Bronx.

The advantage of an EMS system is that indoor room temperatures throughout the building are taken into account as opposed to old systems that only take outside ambient temperatures into account.

The ENERGUARD™ EMS system receives real-time temperature transmissions from wireless space temperature sensors that are placed throughout the building. For example, as more indoor temperature sensors report they are reading below a desired set point temperature of 72 degrees in the winter mode, the ENERGUARD™ system causes the heating plant to kick in.

The ENERGUARD™ EMS provides 24-hour temperature set point changes, thereby lowering the nighttime temperature set point in the winter time to 68 degrees or lower and raising the space temperature to 72 degrees or lower during the day. When no heating or cooling is required as determined by the outside air temperature and internal clock calendar, the heating plant is shut down.

The building's fuel consumption of No. 6 oil decreased by approximately 25% compared with previous years without the EMS system.

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Case study: Thermostatic radiator valves

A major problem with central steam and hot water (hydronic) heat is that the systems usually lack any local control. The temperature at a thermostat dips or it gets cold outside and the boiler control kicks in, sending heat throughout the building. But what if the sun is pouring in a south-facing window or wind cools one side of the building but not the other? These imbalances in load result in discomfort and overheating in parts of the building, leading to windows being opened and more fuel wasted.

What is needed is a way to turn individual radiators on and off with a shutoff valve or to regulate the amount of heat coming from the radiator in response to the temperature in that room. A device that regulates the radiator heat depending on the temperature in the room is called a thermostatic radiator valve or TRV.

When the room is above the desired temperature, the valve is closed and the radiator stays cool even if the boiler is fired by the central control. If the room temperature is below the set point, the radiator functions normally. The result is a room that stays near the desired temperature regardless of excess sunshine, wind-driven infiltration or other uneven thermal loads.

But does it save fuel and money? To answer this question, the New York State Research and Development Authority (NYSERDA) funded a study by EME Engineers. They worked with eight well-run buildings in Brooklyn, Manhattan and Bronx, all with one-pipe steam systems. (One-pipe steam is the case that is hardest to control with TRVs, so any results from this study will also hold for two-pipe steam or hydronic distribution systems.) After undertaking a set of low-cost or no-cost measures like insulating bare pipes, they recorded the fuel use for a year and began a sequenced series of installations of TRVs in five of the buildings. The other three buildings served as controls.

The results were striking and instructive. In one building that did not suffer from imbalances or overheating before the test began, the savings were negligible. The lesson: if you don’t have a problem, you will only need functioning shutoff valves and not necessarily TRVs (or maybe you don’t have a problem because every radiator already has a functioning shut off valve or a TRV).

For the other buildings, however, installing TRVs in the 50% of rooms that were most overheated resulted in savings of 3.7–12.9% (average of 9.5%) and payback periods of 1.2 to 3.6 years. For the two buildings with the greatest savings, TRVs were subsequently installed on the remaining radiators, and the overall savings jumped to 10% and 21%, respectively, with payback periods of 4.7 and 1.3 years.

The conclusion: if a building suffers from significant imbalances, TRVs offer a possible route to greater comfort that will save fuel and pay for itself in a few years.

All buildings are different, however, and you should consult with a competent heating engineer before embarking on a program to install these controls.

Manufacturers: Danfoss (www.danfoss.com/North_America/) is perhaps the most prominent manufacturer, but Macon (http://www.maconcontrols.com/) and Honeywell (customer.honeywell.com/Business/Cultures/en-US/Default.htm) also supply reliable units.

Reference: NYSERDA report 95-14, "Thermostatic Radiator Valve (TRV) Demonstration Project," 1545-EED-BES-91, September 1995, may be obtained from the National Technical Information Service at www.ntis.gov/search/index.aspx by searching for PB96-198163.

Case study: Energy management system

The value of high-quality boiler control is made clear by the savings that occurred when an energy management system (EMS) was installed in a 75-unit assisted living center on Manhattan's Upper West Side. The five-story building has about 27,000 square feet of living space and is heated by hot water circulated through radiators and convectors. The boiler is fired by gas and has a relatively modern and efficient burner.

Gas consumption by the boiler provides both hot water and space heat. Analysis of gas consumption for both a year prior to and a year after the upgrade reveals that about 10,880 therms per year were used for hot water and this usage would not be affected by the improved controller. This is a relatively small amount of fuel for hot water, less than $30 per resident per month.

Prior to the upgrade, a "reset" controller operated the boiler and controlled how much space heat was provided based on outdoor air temperature. Gas consumption for a year prior to the installation was analyzed, the hot water consumption was subtracted out and the remainder amounted to 12,840 therms consumed for heating. This indicates a building that is already efficient: when corrected for size, a typical New York City building would use 40–50% more fuel for heating.

Installing the EMS, which would typically include five temperature sensors for a building this size and a dedicated computer program to make "smart" decisions about how much heat to send up based on the data, resulted in a substantial decrease in the use of gas for heating. After subtracting out the same amount of gas for hot water usage, only 10,330 therms were used for heat. A small share of the decrease was because the second winter was slightly milder, but even after correcting for this, fuel use dropped by more than 15%.

The EMS cost about $23,000, and at a gas price of about $1.70 per therm, the savings are worth about $3,580 per year (corrected to average weather), so the EMS paid for itself in about six years. (Larger buildings would pay back more quickly.) In addition, this socially oriented nonprofit is better insulated from escalating fuel prices now and in the future and has lowered its emissions in proportion to the decrease in fuel use.

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