Appendix A:  
Case studies of costs and savings of heating fuel conversions

All fuel prices are average projected prices between 2010 and 2020 in accordance with the Energy Information Administration Annual Energy Outlook 2009. The interruptible natural gas rate is assumed to be 23% lower than the standard commercial natural gas rate.

Case study 1: Single-family home

Fuel switch from No. 2 heating oil to natural gas

For this study, we assume that the existing boiler is a 100,000 Btu/hr boiler in good working condition and does not require replacement of standard components to operate correctly.

Capital cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas burner</td>
<td>$1,000</td>
</tr>
<tr>
<td>Chimney relined</td>
<td>$ 500</td>
</tr>
<tr>
<td>Removal of oil tank</td>
<td>$ 500</td>
</tr>
<tr>
<td>Natural gas piping *</td>
<td>$1,500</td>
</tr>
<tr>
<td>Condensate pump</td>
<td>$ 100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$3,600</strong></td>
</tr>
</tbody>
</table>

Operating cost

We assume that a single-family home uses 87 mmBtu (621 gallons No. 2 fuel) annually for heating. U.S. average projected prices (2010–2020) are used.

Annual No. 2 oil cost: 621 gallons x $2.87 = $1,782
Annual natural gas cost: 87 mmBtu x $10.73/mmBtu = $ 934

Savings ($ 848)

Payback period: $3,600 / $848 = 4.25 years **

Emission savings (lbs/year): NOx: 3.2 lbs, PM: 0.1 lbs, SOx: 8.8 lbs.

* Assuming no previous natural gas service.

** The natural gas utility may provide incentives to reduce installation costs (see chapter 6). The payback period would generally be shorter if more fuel was used annually. For 1,000 gallons of annual fuel oil use, the annual savings after switching to natural gas would be $1,350 and the payback period would be less than three years.
**Case study 2: 200-unit apartment building**

*Fuel switch from No. 6 residual oil to natural gas (2% efficiency increase); Add a condensing heat exchanger (10% savings)*

For this study, we assume that the boiler is a 5-mmBtu/hr hot water unit in good working condition and does not require replacement of standard components to operate correctly.

**Capital cost**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas burner</td>
<td>$10,000</td>
</tr>
<tr>
<td>Chimney relined</td>
<td>$  5,000</td>
</tr>
<tr>
<td>Secure oil tank</td>
<td>$  3,000</td>
</tr>
<tr>
<td>Natural gas piping</td>
<td>$  6,500</td>
</tr>
<tr>
<td>Condensate pumps</td>
<td>$     500</td>
</tr>
<tr>
<td>Condensing heat exchanger</td>
<td>$10,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$35,000</td>
</tr>
</tbody>
</table>

**Operating cost**

We assume that the building currently uses 5,400 mmBtu (36,000 gallon No. 6 oil) annually for heating.

**Current**

- Annual No. 6 oil purchase: 36,000 gallons x $2.27 = $81,720
- Annual No. 6 oil tank heating (2kW heater @ 7,000kWh) = $ 980
- Annual soot blowing and maintenance $ 3,000
  
  **Total** $85,700

**Proposed**

- Annual natural gas cost: 4,900 mmBtu x $10.73/mmBtu = $52,577
- Annual No. 6 oil tank heating (2kW heater @ 7,000kWh) = $  0
- Annual soot blowing and maintenance $  0
  
  **Savings** $(33,123)

Payback period: $35,000/$33,123 = 1.1 years

**Emission savings (tons/year)**

- NO<sub>x</sub> 0.76 tons
- PM 0.10 tons
- SO<sub>x</sub> 0.85 tons
Case study 3: 500-unit apartment building

Fuel switch from No. 6 residual oil to natural gas/No. 2 oil dual fuel
(1% efficiency increase); Add closed-loop O$_2$ control (5% fuel savings)

For this study, we assume that the boiler is a 10-mmBtu/hr boiler in good working condition and does not require replacement of standard components to operate correctly.

**Capital cost**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual fuel burner</td>
<td>$20,000</td>
</tr>
<tr>
<td>Clean residual fuel tank</td>
<td>$ 3,000</td>
</tr>
<tr>
<td>Secure/ remove residual fuel heating equipment</td>
<td>$ 2,000</td>
</tr>
<tr>
<td>Chimney relined</td>
<td>$ 8,000</td>
</tr>
<tr>
<td>Natural gas piping</td>
<td>$ 8,500</td>
</tr>
<tr>
<td>Condensate pumps</td>
<td>$ 1,000</td>
</tr>
<tr>
<td>Closed-loop O$_2$ control</td>
<td>$15,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$57,500</strong></td>
</tr>
</tbody>
</table>

**Operating cost**

We assume that the building currently uses 10,800 mmBtu (72,000 gallon No. 6 oil) annually for heating

**Current**

- Annual No. 6 oil purchase: 72,000 gallons x $2.27 = $163,440
- Annual No. 6 oil tank heating (4kW heater @ 14,000kW) = $ 1,960
- Annual soot blowing and maintenance = $ 5,000

**$170,400**

**Proposed**

- Annual No. 2 oil purchase: 18,128 gallons x $2.87 = $ 52,027
- Annual natural gas purchase: 7,614 mmBTU x $8.26/mmBTU = $ 62,892
- Annual maintenance = $ 1,000

**$115,919**

**Savings** = ($54,481)

**Payback period** $57,500 / $54,481 = 1.1 years

**Emission savings (tons/year)**

- NO$_x$ 1.47 tons
- PM 0.20 tons
- SO$_x$ 1.56 tons
Cost and savings analysis:

Switching from No. 6 oil to No. 2 heating oil

An 86-unit building burns approximately 50,000 gallons of No. 6 oil. Two years ago, the building was equipped with a new dual fuel burner and a new boiler.

The costs of removing preheater equipment and technical changes to accommodate burning of No. 2 heating oil including cleaning of tank:

One-time expense: $8,500

Yearly additional heating costs if No. 2 heating oil costs 35 cents more than No. 6 oil plus 4% taxes (price per June 16, 2009):

Annual increase in oil costs: $18,200*

Yearly cost savings due to less maintenance costs, less electricity use and less operational costs for No. 2 heating oil:

Annual savings: approx. ($1,500)

To offset the additional heating oil costs, building owners should consider implementing efficiency measures (proper maintenance and fine tuning of boiler system, insulating pipes as well as system upgrades) to reduce the number of gallons of oil burned. Such efficiency measures are described in chapter 5 of this report.

Potential annual savings with 10% fuel savings: approx. ($9,000)

An energy management system (EMS)** could reduce heating oil consumption by about 20%, which would translate into 10,000 fewer gallons burned annually. With No. 2 heating oil prices of June 16, 2009, this would reduce fuel costs annually as follows (including taxes):

Annual fuel savings: approx. ($20,000)

* EIA predicts that No. 2 heating oil will be approximately 60 cents/gallon more expensive than No. 6 oil.

** An EMS costs approximately $20,000.

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