Project No. A-3025

Project Director: Hank Jackson

Sponsor: Georgia Department of Transportation; Atlanta, GA

Type Agreement: Task order #1-1 under Basic Contract dated 3/1/81 (unno. 54).

Award Period: From 8/19/81 To 9/23/81 (Performance) 

Sponsor Amount: $2,616

Cost Sharing: N/A

Title: Energy Management Survey of Aerial Survey Lab and Thomaston District Office

ADMINISTRATIVE DATA

OCA CONTACT: Leamon R. Scott

1) Sponsor Technical Contact: Hugh L. Tyner, Chief; Research & Development Bureau; Department of Transportation; Office of Materials & Research; 15 Kennedy Drive; Forest Park, GA 30050

2) Sponsor Admin./Contractual Contact: same

Reports: See Deliverable Schedule

Security Classification: N/A

Defense Priority Rating: N/A

RESTRICTIONS

See Attached Supplemental Information Sheet for Additional Requirements

Travel: No travel outside state of Georgia shall be allowed unless such travel is listed in cost estimate or approved in writing in advance. Also, prior approval required to increase amount of travel shown in cost estimate.

Equipment: Title vests with sponsor

COMMENTS:

COPIES TO:

Administrative Coordinator
Research Property Management
Accounting Office

Research Security Services
Reports Coordinator (OCA)
Legal Services (OCA)

EES Research Public Rela
Project File (OCA)

Other:
SPONSORED PROJECT TERMINATION SHEET

Date 1/4/82

Project Title: Energy Management Survey of Aerial Survey Lab and Thomaston District Office

Project No: A-3025

Project Director: Hank Jackson

Sponsor: Georgia Dept. of Transportation; Atlanta, GA

Effective Termination Date: 9/23/81

Clearance of Accounting Charges: 9/23/81

Grant/Contract Closeout Actions Remaining:

- [x] Final Invoice and Closing Documents
- [ ] Final Fiscal Report
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other

Assigned to: TAL/ECD (School/Laboratory)

COPIES TO:

Administrative Coordinator
Research Property Management
Accounting
Procurement/EES Supply Services

Research Security Services
Reports Coordinator (OCA)
Legal Services (OCA)
Library

EES Public Relations (2)
Computer Input
Project File
Other
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I. EXECUTIVE SUMMARY

Energy consumption at your plant for the twelve-month period, August 11, 1980 through August 10, 1981 consisted of:

- 291,320 KWH of electricity
- 5565 ccf of natural gas

This is equivalent to 1551 million BTU's of energy. Total energy costs for the period were $19,222.06.

The energy conservation opportunities (ECO's) contained in this report could save an estimated 607 million BTU's each year, or 39% of your total usage. The annual cost savings would amount to approximately $7028, or 37% of your annual energy costs. This figure is based on average energy costs for the past twelve month period. In light of rapidly increasing energy costs, your actual savings may be much greater. You should compare your current energy costs to the average costs used in this report, and adjust the cost savings upward proportionately. The recommendations are:

<table>
<thead>
<tr>
<th>Energy Savings BTU x 10^6</th>
<th>Cost Savings $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Enclose carport</td>
<td>$1046</td>
</tr>
<tr>
<td>(already being done)</td>
<td></td>
</tr>
<tr>
<td>2. Reduce lighting levels</td>
<td>588</td>
</tr>
<tr>
<td>3. Outside lights-photocell</td>
<td>24</td>
</tr>
<tr>
<td>4. Storm windows</td>
<td>1630</td>
</tr>
<tr>
<td>5. High efficiency bulbs</td>
<td>349</td>
</tr>
<tr>
<td>6. Wall insulation</td>
<td>1550</td>
</tr>
<tr>
<td>7. Air conditioning</td>
<td>825</td>
</tr>
<tr>
<td>maintenance</td>
<td></td>
</tr>
<tr>
<td>8. Roof insulation</td>
<td>1016</td>
</tr>
</tbody>
</table>
II. ENERGY MANAGEMENT

Rising energy costs and repeated energy shortages will determine the future of many companies. To meet this challenge, a successful company must have an energy management program to consistently take advantage of every energy conservation opportunity. Several basic steps are required for effective energy management:

- Management Commitment
- Data Analysis
- Goal Setting
- Analysis of Conservation Opportunities
- Implementation of Conservation Techniques
- Continued Feedback and Analysis

The Energy Management program must have the commitment of management for it to produce a long term increase in energy efficiency. A brief, early show of support will only result in small, temporary improvements. Management must design the conservation program as part of its regular, overall company management system. Also, energy costs and the consequences of future energy shortages should be widely disseminated to create an overall energy awareness.

Information must be recorded at regular intervals to support the energy management program. Utility bills and production records may already contain much of the information required. These sources would be adequate to calculate overall energy costs and to determine production efficiency in terms of how much energy is required to manufacture one unit of production. Existing information will probably not detail energy use in each production step, however. Allowances must be made in designing the information base to allow more detailed breakdown of energy consumption as this information becomes available.

Data analysis will be greatly aided if the records use a standard format for all the company's divisions and if the different energy units (such as kilowatt-hours of electricity, gallons of oil, etc.) are converted to a common energy unit, the BTU (British Thermal Unit). One BTU is the amount of energy needed to raise the temperature of one pound of water one degree fahrenheit. By comparing the cost of various fuels on the basis of cost per million BTU's ($/MMBTU), the true cost of each fuel can be determined. The
conversion factors required are:

<table>
<thead>
<tr>
<th>ENERGY UNIT</th>
<th>ENERGY EQUIVALENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kwh</td>
<td>3,412 BTU</td>
</tr>
<tr>
<td>1 Therm</td>
<td>100,000 BTU</td>
</tr>
<tr>
<td>1 Cu Ft Natural Gas</td>
<td>1,000 BTU*</td>
</tr>
<tr>
<td>1 Gallon #2 Oil</td>
<td>140,000 BTU*</td>
</tr>
<tr>
<td>1 Gallon #6 Oil</td>
<td>152,000 BTU*</td>
</tr>
<tr>
<td>1 Gallon Propane</td>
<td>91,600 BTU*</td>
</tr>
<tr>
<td>1 Ton Coal</td>
<td>28,000,000 BTU*</td>
</tr>
</tbody>
</table>

*Varies slightly with supplier.

On a regular basis, whether monthly or annually, progress toward conservation goals should be examined and a new set of goals defined. All goal setting will depend on the opportunities for energy conservation which data analysis has uncovered. More detailed information on specific mechanisms may be required as the program continues the search for energy waste. Forms such as those in the next section should be used as a minimum to aid in the measurement and analysis of energy conservation efforts. Additional forms are enclosed in the appendix for your future use.
ENERGY CONSUMPTION - PAST 12 MONTHS

Name: Georgia State Highway Department - Thomaston District Office
Address: 715 Andrews Drive, Thomaston, GA 30286
Power Distributor: City of Thomaston
Account Number: 8032-00

<table>
<thead>
<tr>
<th>Month</th>
<th>Actual Degree Days</th>
<th>kWh</th>
<th>kW</th>
<th>kVA</th>
<th>Billing Demand</th>
<th>L.F.</th>
<th>P.F.</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 10, 1981</td>
<td>HDD 10, CDD 20</td>
<td>22,120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1,298.44</td>
</tr>
<tr>
<td>Feb 10, 1981</td>
<td></td>
<td>24,880</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,456.00</td>
</tr>
<tr>
<td>Mar 10, 1981</td>
<td></td>
<td>21,480</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,224.39</td>
</tr>
<tr>
<td>Apr 10, 1981</td>
<td></td>
<td>19,200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,138.80</td>
</tr>
<tr>
<td>May 10, 1981</td>
<td></td>
<td>23,480</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,361.79</td>
</tr>
<tr>
<td>Jun 10, 1981</td>
<td></td>
<td>19,640</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,140.00</td>
</tr>
<tr>
<td>Jul 10, 1981</td>
<td></td>
<td>30,280</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,747.80</td>
</tr>
<tr>
<td>Aug 10, 1981</td>
<td></td>
<td>29,240*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,687.71</td>
</tr>
<tr>
<td>Sep 10, 1980</td>
<td></td>
<td>32,600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,920.00</td>
</tr>
<tr>
<td>Oct 10, 1980</td>
<td></td>
<td>30,080</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,784.84</td>
</tr>
<tr>
<td>Nov 10, 1980</td>
<td></td>
<td>19,520</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,224.92</td>
</tr>
<tr>
<td>Dec 10, 1980</td>
<td></td>
<td>18,800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,155.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>291,320</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$17,139.92</td>
</tr>
</tbody>
</table>

Peak Electric Demand: ___________ kW (For buildings over 100,000 gross ft.²)
Total Peak Electric Demand: ___________ kW

*latest bill = $1687.71 = 5.8 c/KWH
### Fossil Fuels

<table>
<thead>
<tr>
<th>Meter Reading Date</th>
<th>Actual Degree Days</th>
<th>Natural Gas</th>
<th>L.P. Gas</th>
<th>Fuel Oil</th>
<th>Coal</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CCF</td>
<td>Gallons</td>
<td>Cost</td>
<td>Gallons</td>
<td>Cost</td>
</tr>
<tr>
<td>Jan 26, 81</td>
<td></td>
<td>1748</td>
<td>667.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb 24, 81</td>
<td></td>
<td>1154</td>
<td>446.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 25, 81</td>
<td></td>
<td>596</td>
<td>238.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr 23, 81</td>
<td></td>
<td>164</td>
<td>70.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 26, 81</td>
<td></td>
<td>64</td>
<td>30.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun 24, 81</td>
<td></td>
<td>49</td>
<td>23.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul 24, 81</td>
<td></td>
<td>37</td>
<td>20.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug 25, 80</td>
<td></td>
<td>78</td>
<td>28.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 25, 81</td>
<td></td>
<td>88</td>
<td>32.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 27, 80</td>
<td></td>
<td>123</td>
<td>43.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov 25, 80</td>
<td></td>
<td>514</td>
<td>169.98</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec 27, 80</td>
<td></td>
<td>950</td>
<td>311.54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td>5565</td>
<td><strong>$2082.14</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*latest bill = \( \frac{\$20.03}{37 \text{ ccf}} \) = 54 \text{ c/ccf}
Customer: DOT Thomaston District Office

1. Existing conditions: Carport area underneath the main floor exposes floor and walls to outside conditions, adding to heat gain/loss.

2. Recommendation: The carport is now being enclosed by DOT. The energy and cost savings expected are summarized below.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh</td>
</tr>
<tr>
<td>Exist. Cond.</td>
<td>291,320</td>
</tr>
<tr>
<td>Rec. Cond.</td>
<td>278,320</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>13,000</td>
</tr>
</tbody>
</table>

4. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $

Estimated useful life of this recommendation in years

Salvage Value $

Disposal Cost $

Estimated cost for design, acquisition & installation of recommended change $

Payback period = Cost of change / Net reduced annual cost = years
ECO-1  Enclose carport (now being enacted)

The effect of enclosing the basement carport area will be to reduce heat loss through the building floor and insulate.

wall heat loss/gain = $A = \frac{38' \times 10^4}{2.98} = 295 \text{ Btu/hr/°F}$

floor heat loss/gain = $43' \times 176' = 476 \text{ Btu/hr/°F}$

$\text{TOTAL} = 771 \text{ Btu/hr/°F}$

Previous bldg heat loss/gain coefficient, including ventilation and infiltration, was 7970 Btu/hr/°F, so this measure will decrease consumption by about 10%.

Heating, gas savings

$0.10 \left( \frac{5400 \text{ ccf}}{yr} \right) = 540 \frac{\text{ccf}}{yr}$

Cooling, compressor/condenser unit electric savings

$0.10 \left( \frac{133,000 \text{ kWh}}{yr} \right) = 13,000 \frac{\text{kWh}}{yr}$

Cost savings

$13,000 \frac{\text{kWh}}{yr} \times 5.8 \frac{\text{¢}}{\text{kWh}} + 540 \frac{\text{ccf}}{yr} \times 54 \frac{\text{¢}}{\text{ccf}} = \$1046$
EN ENERGY CONSERVATION OPPORTUNITY

Customer: DOT Thomaston District Office

ECO Type  4

1. Existing conditions: Lighting levels excessive in some areas.

2. Recommendation: Selectively remove 2 bulbs from certain 4-bulb fluorescent fixtures based on light-meter readings. May keep 4 bulbs in fixtures above desks. Disconnect ballasts on fixtures when removing bulbs.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Exist. Cond.</td>
<td>278,320</td>
</tr>
<tr>
<td>Rec. Cond.</td>
<td>268,195</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>10,125</td>
</tr>
</tbody>
</table>

4. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $ __________

Estimated useful life of this recommendation in years __________

Salvage Value $ __________ Disposal Cost $ __________

Estimated cost for design, acquisition & installation of recommended change $ 180

Payback period = Cost of change / Net reduced annual cost = $180 / $588/yr = 0.3 years
ECO-2 Lighting levels excessive in some areas.
Measurements made:
- Preconstruction room 110 - 150 foot-candles (f.c.)
- Personnel/accounting: 120 f.c.
- Right of way: 140 - 200
- Traffic safety: 200

Of the 180 4 ft x 4 bulb fluorescent fixtures, probably 1/4 can be "delamped" - that is, two bulbs removed and ballast disconnected. Maintain 4 bulbs in fixtures directly over desks.

\[
\frac{180}{4} = 45 \text{ fixtures}
\]

Power reduction: 100 W/fixture
Total = 4.5 kW

At 2250 h\text{yr} operation,
Energy saving = 10,125 kWh \text{yr}^{-1}

Cost saving: @ 5.8 \$/kWh = $584/yr

Estimated electrician time to disconnect ballasts:
= 12 man-hours (1 1/2 days)
Assume $15/man-hour (including overhead)

Payback period = \[\frac{\$180}{\$584/yr} = 3.7 \text{ months}\]
Customer: DOT Thomaston District Office

ECO Type: 4

1. Existing conditions: Outside lights under manual control and are left on during daylight hours on weekends and holidays.

2. Recommendation: Install photocell control to automatically switch on and off lights, depending on daylight conditions.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh (cc ft.)</td>
</tr>
<tr>
<td>Nat. Gas</td>
<td>LP Gas (gal)</td>
</tr>
<tr>
<td>Oil (gal)</td>
<td>Coal (tons)</td>
</tr>
<tr>
<td>Annual</td>
<td>Cost</td>
</tr>
<tr>
<td>Cond.</td>
<td></td>
</tr>
<tr>
<td>Exist.</td>
<td>268,195</td>
</tr>
<tr>
<td>Rec.</td>
<td>267,785</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>410</td>
</tr>
</tbody>
</table>

4. Cost Analysis:
   - Estimated decrease/increase in maintenance cost resulting from this ECO. $ _-
   - Estimated useful life of this recommendation in years 10
   - Salvage Value $ _-
   - Disposal Cost $ _-
   - Estimated cost for design, acquisition & installation of recommended change $ 45
   - Payback period = Cost of change / Net reduced annual cost = $45 / $24/yr = 1.9 years
Outside lighting time or photocell

Outside lights presently controlled manually by switch in lobby. Therefore they are left on during the daylight hours on weekends and holidays.

Holidays: 10 days/yr

Weekends: 2 x 52 = 104 days/yr

total = 114 days/yr

average 12 hr/day

total = 1368 hr/yr

2 (150 watt fixtures) = 0.3 kW

0.3 kW (1368 hr) = 410 kWh, daylight operation

cost of daylight operation @

5.5 $/kWh = $23.80/yr.

Estimated cost to install photocell control for light switchings

Cost of control: $15.00

Electrician

2 hrs @ $15 = 30.00

Total $45.00

payback period = $45.00

23.80 $/yr = 1.9 yrs
Customer: DOT Thomaston District Office

ECO Type _ 3


1. Existing conditions: Single glazed windows

2. Recommendation: Add storm windows

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Exist. Cond.</td>
<td>267,785</td>
</tr>
<tr>
<td>Rec. Cond.</td>
<td>247,385</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>20,400</td>
</tr>
</tbody>
</table>

4. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $ 0

Estimated useful life of this recommendation in years 15

Salvage Value $ 0

Disposal Cost $ 0

Estimated cost for design, acquisition & installation of recommended change $4500

Payback period = Cost of change / Net reduced annual cost = 4500 / $1630/yr = 2.8 years
Storm windows

Present energy cost of single glazed windows:

45 windows, each 3' 3 1/2" x 10'

Transmission

\[ U = 1.13 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F} \]

\[ U_A = 1762 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F} \]

Infiltration total = 1800 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F}

Existing windows = 3562 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F} (including infiltration)

Total building heat loss/gain = 7200 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F}

Revised, with storm windows:

\[ U = 0.55 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F} \]

\[ U_A = 810 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F} \]

Assume infiltration reduced by 1/6

net reduction = (1762 - 810) + 300 = 1252 \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F}

After enclosing carport:

savings = \frac{1252}{7970 - 771} \frac{Btu}{hr \cdot \text{ft}^2 \cdot ^\circ F} = 0.17 \ (17\%)

Heating savings

0.17 (5400 - 540) = 826 ccf

Cooling savings (comparision/condenser units)

0.17 (133,000 - 13,000) = 20,400 kWh

Cost savings @ 5.8 $/kWh = 54.4 $/ccf

20,400 (0.058 $/kWh) + 826 (0.54 $/ccf) = 1,163.00 $/yr

Cost (if means 1981 Cost Data)

Windows = $82.00. Labor = $18. Total = $100 ea.

Total cost = 45 x $100 = $4500

Payback period = $4500 = 2.8 yrs.
ENERGY CONSERVATION OPPORTUNITY

Customer: DOT Thomaston District Office

ECO Type _ 4

1. Existing conditions: Standard 40 watt fluorescent bulbs are used.

2. Recommendation: Change over to 35 watt high efficiency bulbs.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh</td>
</tr>
<tr>
<td>Exist. Cond.</td>
<td>247,385</td>
</tr>
<tr>
<td>Rec. Cond.</td>
<td>241,371</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>6,014</td>
</tr>
</tbody>
</table>

4. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $ 0

Estimated useful life of this recommendation in years 8

Salvage Value $ 0 Disposal Cost $ 0

Estimated cost for design, acquisition & installation of recommended change $1188

Payback period = Cost of change = $1188 = 3.4 years
Net reduced annual cost $349/yr
ECO-5 Lighting

The use of energy-conserving (34-35 watt) bulbs should be instituted on a replacement basis for 40w bulbs as they burn out. They provide nearly as much light, while reducing energy consumption by about 12%.

Alternatively, a complete change-over of all bulbs should be considered. Assume de-lamping ECO already enacted:

\[(180 - 45) \times 4 \text{ bulbs} = 540 \text{ bulbs}\]
\[(9 + 45) \times 2 \text{ bulbs} = \frac{54}{2} \text{ TOTAL = 594 bulbs}\]

Present energy usage of bulbs (ignore ballasts), assume about 90% in use at any given time

594 bulbs (0.90) 40 W 2250 hr 1 w 1000 w = 48,114 \text{ kWh/yr}

Proposed energy usage, 35W bulbs

594 bulbs (0.90) 35 W 2250 hr 1 w 1000 w = 42,099 \text{ kWh/yr}

Energy savings = 48,114 - 42,099 \text{ kWh/yr = 6014 kWh/yr}

Cost savings @ 3.84 = $349/yr

Cost to implement @ $2/bulb; assumes no-cost labor (janitorial/maintenance existing staff)

$2 \times 594 = $1188

Payback period = $1188 / $349/yr = 3.4 yrs
Customer: DOT Thomaston District Office

ECO Type: 2


1. Existing conditions: Walls are uninsulated.

2. Recommendation: Spray on urethane foam insulation on walls and paint.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh</td>
<td>Nat. Gas (cc ft.)</td>
</tr>
<tr>
<td>Exist. Cond.</td>
<td>241,371</td>
<td>4199</td>
</tr>
<tr>
<td>Rec. Cond.</td>
<td>221,371</td>
<td>3470</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>20,000</td>
<td>729</td>
</tr>
</tbody>
</table>

1. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $ 0

Estimated useful life of this recommendation in years 20

Salvage Value $ 0

Disposal Cost $ 0

Estimated cost for design, acquisition & installation of recommended change $ 5230

Payback period = Cost of change = $5230 = 3.4 years

Net reduced annual cost $1550/yr
ECO-6 Wall insulation

Existing walls are uninsulated

Transmission coefficient through walls:

\[ \text{total } R = 2.98 \]
\[ \text{Area} = 4358 \text{ sq. ft.} \]
\[ \text{UA} = \frac{A}{2R} = \frac{4358}{2.98} = 1462 \text{ Btu/ hr. } \text{°F} \]

Total heat loss/gain (after carport is enclosed)

\[ 7970 - 771 = 7199 \text{ Btu/ hr. } \text{°F} \]

Percentage of this loss/gain attributable to walls:

\[ \frac{1462}{7199} = 20\% \]

Present cost of the heat loss/gain through walls:

Heating: \[ 0.20 \times (5400 - 540) \text{ ccf/yr} = 987 \text{ ccf/yr} \]

Cooling: \[ 0.20 \times (133,000 \text{ kwh/yr}) = 26,000 \text{ kwh/yr} \]

Cost:

Heating: \[ 987 \text{ ccf} \times \frac{0.54}{\text{ ccf}} + 26,000 \text{ kwh} \times \frac{0.058}{\text{kwh}} = \$2041/\text{yr} \]

Proposed:

Add 1" thick urethane foam, sprayed on, \( R = 7.7 \)

Revised total \( R = 7.7 + 2.78 = 10.48 \)

\[ \text{UA} = 408 \text{ Btu/ hr. } \text{°F} \]

Net reduction:

\[ 1462 - 408 = 1054 \text{ Btu/ hr. } \text{°F} \]

\[ \frac{1054}{7199} = 15\% \text{ savings (or 75\% of wall heat loss/gain)} \]

Savings:

Heating: \[ 0.15 \times (5400 - 540) = 729 \text{ ccf saved} \]

Cooling: \[ 0.15 \times (133,000) = 20,000 \text{ kwh} \]

Cost saved:

\[ 54 \times (729) + 5.8 \times (20,000) = \$1550/\text{yr} \]

Installation cost:

Ref means 1981 p 117 - sprayed on walls = \$1.03/\text{sq. ft.}

Painting @ \$0.17/\text{sq. ft.} total = \$1.20

4358 sq ft \times \$1.20/\text{sq ft} = \$5230

Pouitch cover = \$5230 + \$1550/\text{yr} = 3.4 \text{ yrs.}
Customer: DOT Thomaston District Office

ECO Type 9


1. Existing conditions: Construction causing dusty conditions, low air flow in some areas (file room), coil (evaporator) on air-handler in new section is iced-over.

2. Recommendation: Charge refrigerant, clean coils, clean fans and ducts, after construction is completed.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nat. Gas</td>
</tr>
<tr>
<td>kW</td>
<td>(cc ft.)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Exist. Cond.</td>
<td>221,371</td>
</tr>
<tr>
<td>Rec. Cond.</td>
<td>209,571</td>
</tr>
<tr>
<td>Net Reduction</td>
<td>11,800</td>
</tr>
</tbody>
</table>

4. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $0

Estimated useful life of this recommendation in years 5

Salvage Value $0  Disposal Cost $0

Estimated cost for design, acquisition & installation of recommended change $3000

Payback period = Cost of change = $3000 = 5 years
Net reduced annual cost $600/yr (average)
ECO-7  Air conditioning cleaning

General maintenance on the air conditioning system appears warranted:
1. Evaporator coil in air-handler was iced-over (new section)
2. Low air flow was observed in at least one area (file room)

Charging of refrigerant, cleaning coils, and cleaning fan and ducts recommended, after present construction is completed.

Expected savings: air-conditioning, compressor

Consumption est. 10% saving
present consumption (est.

(23.2 + 37.2) kW 2000 h = 120,800 kWh

estimated consumption following service: 1800 h (60.4 kW) = 109,000 kWh

Energy savings = 11,800 kWh

Cost savings @ 5.5 $/kwh = $66.4/yr

Expected savings, gas consumption reduced due to improved heat transfer efficiency 2.5% present heating gas = 5191 ccf/yr

expected heating gas = 0.75 (5191) = 4931 ccf/yr

energy savings = 260 ccf/yr

Cost savings @ 57 $/ccf = $14.8/yr

Total savings = $88.2/yr (10 yr) 700 600 500 400

Estimated cost of service: $3000

Payback period = $3000 = 5 yrs

$600/yr
Customer: DOT Thomaston District Office

ECO Type_ 2


1. Existing conditions: Limited insulation in roof of old section.

2. Recommendation: Spray on urethane foam on top of existing roof, one-inch thick for additional R = 7.7.

3. Existing vs. recommended conditions

<table>
<thead>
<tr>
<th>Electric</th>
<th>Fossil Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>kWh</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Exist. Cond.</strong></td>
<td></td>
</tr>
<tr>
<td>209,571</td>
<td>3210</td>
</tr>
<tr>
<td><strong>Rec. Cond.</strong></td>
<td></td>
</tr>
<tr>
<td>196,571</td>
<td>2724</td>
</tr>
<tr>
<td><strong>Net Reduction</strong></td>
<td></td>
</tr>
<tr>
<td>13,000</td>
<td>486</td>
</tr>
</tbody>
</table>

4. Cost Analysis:

Estimated decrease/increase in maintenance cost resulting from this ECO. $ 0

Estimated useful life of this recommendation in years 30

Salvage Value $ 0 Disposal Cost $ 0

Estimated cost for design, acquisition & installation of recommended change $10,000

Payback period = Cost of change = $10,000 = 9.9 years
Net reduced annual cost $1016/yr
ECO-8  Roof insulation - old section

Present energy cost of ceiling, 10,560 sq ft

\[ UA = 1388 \frac{\text{Btu}}{\text{hr} \cdot \text{F}} \]

Total building heat loss (gain) = \( 7200 \frac{\text{Btu}}{\text{hr} \cdot \text{F}} \) (carpet enclosed)

Revised spray on methane foam on top of existing roof

1" thick

\[ R = 7.7 \text{ additional} \]

Revised \( U = 0.06 \)

\[ UA = 676 \frac{\text{Btu}}{\text{hr} \cdot \text{F}} \]

Savings = 1388 - 676 = \( 712 \frac{\text{Btu}}{\text{hr} \cdot \text{F}} \)

\[ \frac{712}{7200} = \text{approx} 10\% \text{ savings} \]

Energy cost savings

heating = 0.10 (4860 ccf/yr) = 486 ccf/yr

cooling (compressor, condenser units only)

= 0.10 (133,000 kWh/yr) = 13,000 kWh/yr

Cost savings @ 5.8 $/kWh = 54 $/ccf

13,000 (0.058) + 486 (0.54) = $1016/yr

Cost of installation

1981 cost data

- Materials (methane, sprayed) \( \$ 0.22/\text{sq ft} \)
- Labor \( \$ 0.52/\text{sq ft} \)

Total (including overhead & profit) \( \times 0.75 \)

\[ \text{cost} = \$ 0.75 (10,560 \text{sq ft}) \]

Payback period = \( \frac{\$13,000}{\$1016/yr} = 9.9 \text{ yrs} \)
DOT Thomaston District office - Energy analysis

Summary

- **1981 addition not considered in this report.**

**AREAS**

- **A1-B1 Original construction:** 1956 = 15,360 sq ft
- **A2-B2 Addition:** 1966, added 56 ft on 3 sides, including basement = 7168 sq ft

**Total area:** 22,528 sq ft

- **First floor:** 15,483 sq ft
- **Basement:** 7,040 sq ft

**Total energy consumption, annual:**

- **Electric:** 291,320 kWh = 9.94 x 10^6 Btu ($17,140)
- **Gas:** 5565 ccf = 5.70 x 10^6 Btu ($2,082)

**Space fl. basis:** 44,390 Btu/ssf = $0.85/ssf
Building envelope

Roof sections: AREA A1

<table>
<thead>
<tr>
<th>Layer</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air</td>
<td>0.17</td>
</tr>
<tr>
<td>Built-up roof</td>
<td>0.33</td>
</tr>
<tr>
<td>1&quot; Rigid insul.</td>
<td>2.79</td>
</tr>
<tr>
<td>2&quot; Gypsum concrete</td>
<td>1.20</td>
</tr>
<tr>
<td>1&quot; Acoustical foam</td>
<td>2.50</td>
</tr>
<tr>
<td>Inside air</td>
<td>0.62</td>
</tr>
</tbody>
</table>

$$\sum R = 7.61$$

$$A = \text{Roof area } A1 = 88 \times 120 = 10,560 \text{ ft}^2$$

$$U_A = \frac{A}{\sum R} = 1388 \frac{\text{Btu}}{\text{hr} \cdot \text{F}}$$

Roof sections: AREA A2

<table>
<thead>
<tr>
<th>Layer</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air</td>
<td>0.17</td>
</tr>
<tr>
<td>Built-up roof</td>
<td>0.33</td>
</tr>
<tr>
<td>1&quot; Rigid insul.</td>
<td>2.79</td>
</tr>
<tr>
<td>2&quot; Gypsum conc.</td>
<td>1.20</td>
</tr>
<tr>
<td>Air space</td>
<td>0.98</td>
</tr>
<tr>
<td>3½&quot; Fiberglass batts</td>
<td>11.00</td>
</tr>
<tr>
<td>½&quot; Suspended air tile</td>
<td>1.25</td>
</tr>
<tr>
<td>Inside Surface</td>
<td>0.62</td>
</tr>
</tbody>
</table>

$$\sum R = 18.34$$

$$A = \text{Roof area } A2 = 88 \times 56 = 4928 \text{ ft}^2$$

$$U_A = \frac{A}{\sum R} = 269 \frac{\text{Btu}}{\text{hr} \cdot \text{F}}$$

Basement roof sections B1/B2 not considered, because adjoining into heated/fully heated space.
Walls (ignoring wall in basement facing ground)  
\[
ZR = 2.98 \\
\text{Wall area} = 10' \left( \frac{(176 \times 2) + (88 \times 2) + (40 \times 2)}{2} \right) \\
\text{minus doors} \div \text{windows} \\
6080 \text{ft}^2 - 1559 = 4751 \text{ft}^2 \\
UA = \frac{A}{ZR} = \frac{4356}{2.98} = 1462 \text{ Btu/hr}^\circ\text{F} \\
\text{Windows} \\
45 @ 3'3\frac{1}{4}'' \times 10' = 1472 \text{ ft}^2 \\
2 @ 2' \times 6\frac{3}{4}'' = 27 \text{ ft}^2 \\
1 @ 6 \times 10 = 60 \text{ ft}^2 \\
1559 \text{ ft}^2 \quad U = 1.13 \\
UA = 1559 \times 1.13 \text{ Btu/hr}^\circ\text{F} = 1762 \text{ Btu/hr}^\circ\text{F} \\
\text{Doors} \\
2 @ 6 \times 7' \text{ hollow metal w/2 2\frac{1}{2}' \times 5' windows} \quad U = 1.05 \\
1 @ 6 \times 7' \text{ hollow metal, no windows} \quad U = 0.89 \\
2 @ 3 \times 7' \text{ hollow metal} \quad U = 0.89 \\
UA = 84 \text{ ft}^2 \times 1.05 + 42 \text{ ft}^2 \times 0.89 + 12 \text{ ft}^2 \times 0.89 = 163 \text{ ft}^2/hr \\
\text{Floor (above carpet, now being analyzed) } \\
\begin{align*}
\text{inside surface} & : 0.62 \\
\text{asphalt tile} & : 0.05 \\
\text{2'' concrete} & : 0.22 \\
\text{4'' vermiculite-sand conc.} & : 3.44 \\
\text{corrugated deck} & : 0.98 \\
\text{air space} & : 0.98 \\
\text{3'3'' fibreglass batts} & : 1.00 \\
\text{formboard ekg} & : 1.25 \\
\text{outside surface} & : 0.17 \\
ZR = 17.73 
\end{align*}
Floor cond'd

\[ \frac{A}{E} = \frac{48 \times 176}{17.73} = 476 \text{ Btu/hr/F} \]

Ventilation and infiltration

Blog conditions - avg. tightness, some opening windows
assume 0.5 air changes/hr for infiltration

Ventilation - outside air

spect: old air handler = 1950 cfm o.a.
new section a.h. = 1000 cfm o.a. (estimated)
2950 cfm o.a.

design ventilation = 2950 cfm o.a. 60 min \( \frac{\text{cfm}}{\text{hr}} \)= 177,000 \( \frac{\text{ft}^3}{\text{hr}} \)

Outside air damper in old section found fully open,
assume ventilation = 2500 cfm (old section)
actual ventilation (est.) = 3500 cfm 60 min \( \frac{\text{cfm}}{\text{hr}} \)= 219,000 \( \frac{\text{ft}^3}{\text{hr}} \)

Building volume = 22,528 \( \text{ft}^3 \) 7 ft (avg. h.) = 202,752 \( \text{ft}^3 \)

Infiltration 0.5 (202,752 \( \frac{\text{ft}^3}{\text{hr}} \)) = 101,000 \( \frac{\text{ft}^3}{\text{hr}} \)
heat loss/gain =

\[ \dot{m}_p = 101,000 \frac{\text{ft}^3}{\text{hr}} \times 0.075 \frac{16}{\text{ft}^3} \times 0.24 \frac{\text{Btu}}{\text{hr/F}} = 1800 \frac{\text{Btu}}{\text{hr/F}} \]

Ventilation heat loss/gain =

\[ \dot{m}_p = 219,000 \frac{\text{ft}^3}{\text{hr}} \times 0.075 \frac{16}{\text{ft}^3} \times 0.24 \frac{\text{Btu}}{\text{hr/F}} = 3800 \frac{\text{Btu}}{\text{hr/F}} \]
Floor, cont'd

\[ UA = \frac{A}{2R} = \frac{48' \times 176'}{17.73} = 476 \text{ Btu hr}^{-1}^\circ \text{F} \]

Ventilation

very little outside air used.
Old bldg - damper was closed
New bldg - damper nearly closed

assume 600 cfm

volume/hr = 600 \ \text{ft}^3 \text{ min}^{-1} \times \frac{60 \text{ min}}{\text{ hr}} = 36,000 \ \text{ft}^3 \text{ hr}^{-1}

heat loss/gain = mass flow x specific heat

\[ 36,000 \ \text{ft}^3 \text{ hr}^{-1} \times 0.075 \ \frac{\text{Btu}}{\text{ft}^3} \times 0.24 \ \frac{\text{Btu}}{\text{ft}^3} \times \frac{1}{10^{\circ} \text{F}} = 650 \ \text{Btu hr}^{-1}^\circ \text{F} \]

Infiltration

building conditions relatively tight, assume 1 air change per hour
bldg vol. = 200,000 cu.ft.

\[ (0.5)(200,000 \ \text{cu.ft.}) = 100,000 \ \text{cu.ft. \ hr}^{-1} \]

heat loss/gain

\[ 100,000 \ \text{ft}^2 \times 0.075 \ \frac{\text{Btu}}{\text{ft}^2} \times 0.24 \ \frac{\text{Btu}}{\text{ft}^2} \times \frac{1}{10^\circ \text{F}} = 1300 \ \text{Btu hr}^{-1}^\circ \text{F} \]
Total building loads

Transmission

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>roof (old)</td>
<td>1388</td>
<td>8 Fh/ft²°F</td>
</tr>
<tr>
<td>roof (new)</td>
<td>269</td>
<td></td>
</tr>
<tr>
<td>walls</td>
<td>1462</td>
<td></td>
</tr>
<tr>
<td>windows</td>
<td>1762</td>
<td></td>
</tr>
<tr>
<td>doors</td>
<td>163</td>
<td></td>
</tr>
<tr>
<td>floor</td>
<td>476</td>
<td></td>
</tr>
</tbody>
</table>

Ventilation

Ventilation

Infiltration @0.5 air change/hr = 1800

∑ = 7970 8 Fh/ft²°F

Annual heating requirement

2400 MDO (Ref: Talbotton 6A)

\[
\frac{17970 \text{ Btu}}{\text{hr F}} \times \frac{2400 \text{ °F day}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{1 \text{ day}} (0.85) = 5.57 \times 10^8 \text{ Btu/yr}
\]

(0.70)

0.85 - Degree day credit factor for time clock

with night setback (15% savings)

0.70 - boiler & system heat transfer efficiency

boiler (0.80) \times \text{ system (0.87)}

gas reqd = \frac{5.32 \times 10^8 \text{ Btu}}{102400 \text{ cfm}} = 5443 \text{ ccf/yr}
Energy Balance

Lighting

**Incandescent**

<table>
<thead>
<tr>
<th>Bulb Type</th>
<th>Wattage</th>
<th>Total Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 @ 150W</td>
<td>4350W</td>
<td></td>
</tr>
<tr>
<td>1 @ 100W</td>
<td>100W</td>
<td></td>
</tr>
<tr>
<td>63 @ 60W</td>
<td>3780W</td>
<td></td>
</tr>
<tr>
<td>4 @ 20W</td>
<td>80W</td>
<td></td>
</tr>
</tbody>
</table>

Total: **8310W = 8.3 kW**

**Fluorescent**

<table>
<thead>
<tr>
<th>Bulb Type</th>
<th>Wattage</th>
<th>Total Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 ea.4 bulb 4 ft</td>
<td>@ 200W = 36,000W (incl. ballast)</td>
<td></td>
</tr>
<tr>
<td>9 ea.2 bulb 4 ft</td>
<td>@ 100W = 900W</td>
<td></td>
</tr>
<tr>
<td>16 ea.2 bulb 8 ft</td>
<td>@ 200W = 3,200W</td>
<td></td>
</tr>
<tr>
<td>14 ea.1 bulb 8 ft</td>
<td>@ 100W = 1,400W</td>
<td></td>
</tr>
<tr>
<td>11 circ.</td>
<td>@ 40W = 440W</td>
<td></td>
</tr>
<tr>
<td>8 ea.1 bulb 2 ft</td>
<td>@ 25W = 200W</td>
<td></td>
</tr>
</tbody>
</table>

Total: **42,140W = 42.1 kW**

**Total Lighting** = **50.4 kW**

avg 40 kW on
avg 2250 hrs/yr. = **90,000 kWh**

**Building Equipment**

<table>
<thead>
<tr>
<th>Unit</th>
<th>KW (total)</th>
<th>HRS/yr</th>
<th>KWH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Compressor</td>
<td>0.8</td>
<td>100</td>
<td>80 kWh</td>
</tr>
<tr>
<td>Unit Heaters (8)</td>
<td>13.2</td>
<td>300</td>
<td>3960 kWh</td>
</tr>
<tr>
<td>Terminal (Computer)</td>
<td>1.0</td>
<td>500</td>
<td>500 kWh</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>3.0</td>
<td>1500</td>
<td>4500 kWh</td>
</tr>
<tr>
<td>Cold Drink Machines</td>
<td>2.0</td>
<td>1500</td>
<td>3000 kWh</td>
</tr>
<tr>
<td>Small Copiers</td>
<td>1.5</td>
<td>500</td>
<td>2250 kWh</td>
</tr>
<tr>
<td>Large Copier</td>
<td>3.5</td>
<td>800</td>
<td>2800 kWh</td>
</tr>
<tr>
<td>Blueprint</td>
<td>10.0</td>
<td>1000</td>
<td>10000 kWh</td>
</tr>
<tr>
<td>Coffee, Microwave, etc.</td>
<td>5.0</td>
<td>200</td>
<td>1000 kWh</td>
</tr>
<tr>
<td>Misc.</td>
<td>3.0</td>
<td>500</td>
<td>1500 kWh</td>
</tr>
</tbody>
</table>

**Total: 29,590 kWh**

round off 30,000 kWh
HVAC

Air handlers:
New bldg.
fan = 3.0 kW
hrs operation = 3000/yr

energy = 3.0 kW x 3000 yr = 9,000 kwh

Old bldg.
fan = 10.0 kW
hrs operation = 3000/yr

energy = 10 kW x 3000 yr = 30,000 kwh

A/C compressor-condenser units
New bldg. (Bryant)
Compressors (2) 36A 208V 3φ = 10.4 kW ea.
Condenser fans (4) 3.6A 208V 1φ = 0.6 kW ea.
total = 2(10.4) + 4(0.6) = 23.2 kW

Old bldg. (York)
Compressor 120A 208V 3φ = 34.6 kW
condenser fans (9) 3.9A 208V 1φ = 0.65 kW ea.
total = 34.6 + 9(0.65) = 37.2 kW

Large self-contained unit (Rheem) above stairs
Compressor 14.7A 208V 1φ = 2.5 kW
fans 3.3A 208V 1φ = 0.63 kW
total = 2.5 + 0.63 = 3.18 kW

Two window units 1.5 kW each

Total A/C = 66.53 kW

@ 2000 hr: equipment full load hours
= 133,000 kwh
ENERGY CONSUMPTION - PAST 12 MONTHS

Name: ________________________________ __ _________
Address: ___________________________________________________ _ __________ __
Power Distributor: ____________________________________________
Account Number: _________________________________________________ ___
Minimum Bill __________________________________________ Contract Demand Cost: __________

<table>
<thead>
<tr>
<th>Meter Reading Date</th>
<th>Actual Degree Days</th>
<th>kWh</th>
<th>kW</th>
<th>kVa</th>
<th>Billing Demand</th>
<th>L.F.</th>
<th>P.F.</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mo/Day/Yr</td>
<td>HDD</td>
<td>CDD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan</td>
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Peak Electric Demand: _______ kW (For buildings over 100,000 gross ft.²)

Peak Electric Demand: _______ kW
## Fossil Fuels

<table>
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<tr>
<th>Meter Reading Date</th>
<th>Actual Degree Days</th>
<th>Natural Gas</th>
<th>L.P. Gas</th>
<th>Fuel Oil</th>
<th>Coal</th>
<th>Cost</th>
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| Jan                |                    |             |          |          |       |      |
| Feb                |                    |             |          |          |       |      |
| Mar                |                    |             |          |          |       |      |
| Apr                |                    |             |          |          |       |      |
| May                |                    |             |          |          |       |      |
| Jun                |                    |             |          |          |       |      |
| Jul                |                    |             |          |          |       |      |
| Aug                |                    |             |          |          |       |      |
| Sep                |                    |             |          |          |       |      |
| Oct                |                    |             |          |          |       |      |
| Nov                |                    |             |          |          |       |      |
| Dec                |                    |             |          |          |       |      |
| Totals             |                    |             |          |          |       |      |