Farm Energy IQ

Farm Energy Audits

Tom Manning, New Jersey Agricultural Experiment Station
Energy Audit

• An energy audit is the process of determining energy consumption of a building or facility (Source: U.S. DOE – EERE)

• The purpose of an energy audit is to quantify energy use in a facility or operation and to prioritize opportunities for reducing energy use
Agricultural Energy Audit - Definition

• “...to determine and document current energy usage, and to provide an estimation of energy savings from alternatives in the cultivation, protection, harvesting, processing and storage of agricultural commodities and in the feeding, housing and processing of farm animals and animal products.”

Source: American Society of Agricultural and Biological Engineers Standard S612
Questions an Energy Audit Should Answer

• How much energy does the operation use?
• What are the major uses of energy?
• Why?
• What steps will reduce energy consumption?
Conducting Energy Audits

- NRCS certifies Technical Service Providers (TSPs) to conduct agricultural audits.
- NRCS provides funding for agricultural audits based on a fee structure related to size and type of operation.
- ASABE S612 discusses qualifications for audit professionals.
- Not only is agriculture different from commercial and industrial operations, but different sectors within agriculture use energy in very different ways.
Components of an Audit

• Compilation of utility bills
• Visual inspection
• Characterization of equipment and systems
• Interviews
• On-site measurement and testing
  • Blower door
  • Power measurement
  • IR imaging
  • Hours of operation - lights and motors
• Simulation modeling
What to Expect from an Audit

- Facility summary and status
- Summary of use by application or location
- Characterization of equipment and systems
- Identification of trends
- Interviews
- Summary of energy use by energy resource
- Summary of energy costs
- Identification of peak demands
- Compilation of energy use per unit
- Inventory of equipment and systems
- Energy conservation opportunities
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Facility Summary and Status

• Overview of the operation
• Building summary
  • Area
  • Use
  • Construction details
• Infrastructure summary
  • Electric supply
  • Fuels
  • Major systems
Key:
A - Store and old kitchen
B - New Building and kitchen
C - Storage
D - Shop
E - Processing and Packing
F - Garage
G - Greenhouse (CSA)
H - Farm Stand
I - Poultry House (Quail)
J -
4 - 17 - Poultry Houses
Building A:
Use: Product sales, storage, food preparation.
Area: 600 square feet
Heating: Natural gas hot air furnace
  Coleman G8T13020UHD11A furnace, 130,000 Btu/hr input, 104,000 Btu/hr output, 80% efficient
Ventilation: Range hood
Cooling: Coil in furnace ductwork
  Zone 1: Trane RAUC C20 20 ton air conditioner with Trane air handler (total of 4 hp)
Controls: 7 day thermostat
Hot water (Natural Gas):
  Bradford White MI50036FBN 50 gallon 40,000 Btu/hr, 78% efficient
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Summary of Use by Application or Location

- Lighting
- Ventilation
- Refrigeration
- Milk harvesting
- Controllers
- Other motors and pumps
- Water heating
- Air heating/building environment
- Drying
- Waste handling
- Air cooling
- Cultural practices
- Storage
Summary of Use by Application (ASABE S612)

- Waste handling
- Air cooling
- Cultural practices
- Storage
- Water management
- Material handling
- Irrigation
Breakdown of Electricity Use

Estimated Electric Use by Application

- Air Conditioning: 38%
- Equipment: 22%
- Chiller: 17%
- Lights: 15%
- Other: 7%
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## Electric Bills - Storage Barn

Area: 4,800 Square feet

<table>
<thead>
<tr>
<th>Billing Period</th>
<th>Amount Billed</th>
<th>kW-hr</th>
<th>KVA</th>
<th>¢/kW-hr</th>
<th>kW-hr per sq. foot</th>
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<td><strong>Maximum:</strong></td>
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<td><strong>Average:</strong></td>
<td><strong>$241.58</strong></td>
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Equipment Summary

- Equipment summary by location
  - Motors, refrigeration equipment, fans, boilers and furnaces, fans, pumps, other
  - Equipment capacity, efficiency, and runtime
- Lighting summary by location
  - Type
  - Quantities
  - Hours of use
## Tabulation of Large Equipment

<table>
<thead>
<tr>
<th>Location</th>
<th>Equipment</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Motor Manufacturer</th>
<th>Model</th>
<th>HP</th>
<th>kW</th>
<th>RPM</th>
<th>V</th>
<th>A</th>
<th>Ph</th>
<th>Hz</th>
<th>Eff.</th>
<th>P.F.</th>
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<td>Pump</td>
<td>Liverani</td>
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<td>1.5</td>
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<td>220</td>
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<td>VFD Pump</td>
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<td>0.9</td>
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<td>Pump</td>
<td>Liverani</td>
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<td>4.0</td>
<td>1740</td>
<td>220</td>
<td>15.2</td>
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<td>60</td>
<td>77%</td>
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<td>Chiller Pump</td>
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<td>ALPHA 80</td>
<td>Baldor</td>
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<td>78%</td>
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<tr>
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<tr>
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</table>
## Heating Equipment Summary

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<tr>
<th>Location / Area Description</th>
<th># of Heaters</th>
<th>Type of Heater</th>
<th>Btu/hr Output</th>
<th>Make / Model</th>
<th>Fuel Type</th>
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<tbody>
<tr>
<td>Propane Boiler</td>
<td>1</td>
<td>Gas-Fired Boiler</td>
<td>300,000</td>
<td>Slant Fin GG-375</td>
<td>Propane</td>
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<td>Outdoor Furnace</td>
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<td>Wood-Fired Boiler</td>
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<td>Big Eliminator 60</td>
<td>Wood</td>
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<td>Greenhouse #1</td>
<td>12</td>
<td>Forced Hot Air</td>
<td>180,000</td>
<td>Modine</td>
<td>Propane</td>
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<td>Greenhouse #1</td>
<td>2</td>
<td>Forced Hot Air</td>
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<td>Reznor UPAP300</td>
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<td>Forced Hot Air</td>
<td>89,000</td>
<td>Reznor WS96/120</td>
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<td>Greenhouse #2</td>
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# Lighting Summary

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<th>Hrs.</th>
<th>CFL/LED Watts</th>
<th>Qty.</th>
<th>kWh</th>
<th>Total kWh</th>
<th>Incand. Watts</th>
<th>Qty.</th>
<th>kWh</th>
<th>Total kWh</th>
<th>Other Watts</th>
<th>Qty.</th>
<th>kWh</th>
<th>Total kWh</th>
<th>Linear Fluorescent Watts</th>
<th># Bulbs</th>
<th>Type</th>
<th>kWh</th>
<th>Total kWh</th>
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**TOTALS:** 923 580 4,439 2,122 919 595 6,531 1,870
What to Expect from an Audit

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- Summary of use by application or location
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<table>
<thead>
<tr>
<th>Location</th>
<th>Recommended Measure</th>
<th>Electric Savings (kWh)</th>
<th>Propane Savings (Gal)</th>
<th>Installed Cost</th>
<th>Energy Cost Savings</th>
<th>Payback (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasting Room</td>
<td>Replace incandescent bulbs with LEDs</td>
<td>3,403</td>
<td></td>
<td>$650</td>
<td>$851</td>
<td>0.8</td>
</tr>
<tr>
<td>Lab</td>
<td>Replace T-12 fluorescent fixtures with T-8 fixtures</td>
<td>197</td>
<td></td>
<td>$200</td>
<td>$70</td>
<td>2.9</td>
</tr>
<tr>
<td>Winery</td>
<td>Insulate Walls</td>
<td>2,069</td>
<td>828</td>
<td>$13,600</td>
<td>$3,748</td>
<td>3.6</td>
</tr>
<tr>
<td>Winery</td>
<td>Replace T-12 fluorescent fixtures with T-8 fixtures</td>
<td>548</td>
<td></td>
<td>$500</td>
<td>$137</td>
<td>3.7</td>
</tr>
<tr>
<td>Small Office</td>
<td>Replace refrigerator</td>
<td>404</td>
<td></td>
<td>$800</td>
<td>$101</td>
<td>7.9</td>
</tr>
<tr>
<td>Winery</td>
<td>Replace chiller</td>
<td>8,176</td>
<td></td>
<td>$20,000</td>
<td>$2,044</td>
<td>9.8</td>
</tr>
<tr>
<td>Lab</td>
<td>Replace hot water heater with 90% efficient heater</td>
<td>52</td>
<td></td>
<td>$2,500</td>
<td>$204</td>
<td>12.3</td>
</tr>
</tbody>
</table>
Current vs. Proposed Propane Use

Estimated Propane Savings
(gallons/year)

- 800
- 600
- 400
- 200
- 0

Current
Projected
Current vs. Proposed Electricity Use

Projected Electric Use by Application

(kW-hr per year)

Current

- Lighting: 8,121
- Cooling: 7,855
- Other: 23,606

Projected

- Lighting: 3,403
- Cooling: 3,550
- Other: 23,202
Farm Energy IQ

Farm Energy Audits

Questions?