Powering Michigan Agriculture with Renewable Energy
ENERGY AUDIT
&
RENEWABLE ENERGY ASSESSMENT
ENERGY PYRAMID

- Renewable Energy
- Time of Use Management
- Energy Efficiency
- Energy Conservation
- Energy Analysis
MICHIGAN STATE UNIVERSITY

• MI Agricultural Energy Use Significant
  • MI Dairy Farms Energy Use
    • $100/cow energy usage
    • 355,000 milking cows in MI
• Training & Certification - MSU Biosystems & Agricultural Engineering Department
• Agricultural Emphasis
• MSU contributor to development of national standard
MICHIGAN STATE UNIVERSITY

• Other MSU departments, State agencies, utility companies & organizations involved
• Initially Dairy & Greenhouse Energy Auditors
• Energy Audit process applicable to others
• Process also applicable to Renewable Energy Assessments
MSU Certified Farm Energy Auditors

• Variety of Energy Audits
  • Dairy, Greenhouse, Grain Drying, Irrigation, Poultry, Swine & Rural Business
  • Rural Business – Pop < 50,000
• Renewable Energy Assessments
  • Wind, Solar, AD & Geothermal
  • Funding Applications
• USDA, DOE, State of MI
Why do an Energy Audit or Renewable Energy Assessment?

What are benefits?

What is the process?
Why Do an Energy Audit?

- Energy Usage = $
- Energy Cost increases inevitable
- Energy $avings are viable opportunities
- Energy saving improvements improve operations
- Long-term & environmental benefits
- It is the right thing to do
Why Do an Renewable Energy Assessment?

- Energy Usage = $
- Energy Cost increases inevitable
- Renewable Energy Systems are viable
- Solar – 20kW system $120k, now $70k
- Long-term & environmental benefits
- It is the right thing to do
Michigan Energy Sources

- Petroleum: 97% from Imports, 3% from MI Source
- Natural Gas: 80% from Imports, 20% from MI Source
- Coal: 100% from Imports, 0% from MI Source

~$40 billion
What are Benefits?

• Documents current energy usage by components – establishes baseline
  • Based on historical utility records
  • Lighting, heating, motors, etc.
• Considers energy saving alternatives
• Or renewable energy opportunities
What are Energy Audit Benefits?

• Prioritizes list of energy improvements
• Potential Energy Savings
• Cost Estimates yield Payback Period
• Documents value of energy improvements already in place
• Qualifies improvements for funding incentives
What are Energy Audit Benefits?

• Operational Improvements
  • Additional lighting
  • Long-day lighting
  • LED grow lights
  • Phase converters
  • Variable frequency drives
  • Sales tax exemption?
What are Renewable Energy Assessment Benefits?

- Establishes baseline utility usages
- Educational - provides information
- Energy potential based on supplier or on-line data sources
- Municipal & utility requirements
- Costs, revenue and funding sources
MSU Energy Audit Process

• Operational Understanding - Key
• On-site Review & Data Acquisition
• MSU – Technical Resources
• Energy Baseline & Inventory
• Management Tool for Energy Planning
• Potential Improvements & Costs
Quantifies Energy Usage

1. Heating Systems
2. Cooling Systems
3. Lighting
4. Water Heating
5. Irrigation
6. Ventilation
7. Any energy use, i.e. wood
Dairy Energy Usages

- Milking: 12%
- Lighting: 16%
- Water Heating: 18%
- Milk Cooling: 20%
- Manure Handling: 14%
- Feeding: 2%
- Space Heating: 4%
- Misc.: 6%
- Ventilation: 8%

Michigan 2010
Energy Usage

![Energy Usage Chart]

- Natural Gas Usage: MCF/Month
- 2009 Natural Gas MCF/Month
- 2010 Natural Gas MCF/Month

<table>
<thead>
<tr>
<th>Month</th>
<th>2009 MCF</th>
<th>2010 MCF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov</td>
<td></td>
<td></td>
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<tr>
<td>Dec</td>
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<tr>
<td>Jan</td>
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<td>Jun</td>
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<td>Sep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct</td>
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</tbody>
</table>
Certified Energy Audit

• Conforms to; ANSI/ASABE S612, July 2009
• ANSI – American National Standards Institute
• ASABE – American Society of Agricultural & Biological Engineers
• Tier II Energy Audit
• USDA Acceptance – Nationally
• Utility Company Acceptance
Certified Energy Audit

• Energy Efficiency Recommendations
  • Quantifies Energy Savings
  • Provides Cost Estimates
  • Computes Payback Period

• 10% to 40% Energy Savings
Defines Energy Alternatives

- Heating equipment options
- Cooling equipment options
- Lighting improvements
- Water heating options
- Irrigation pumps, motors & system upgrades
- Ventilation equipment
- Energy curtains
- Weatherization
- Grain drying equipment
## Energy Conservation Measures

<table>
<thead>
<tr>
<th>Electricity Energy Source</th>
<th>Savings/Year</th>
<th>Cost to Replace</th>
<th>Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energy (kWh)</td>
<td>Energy (MMBtu)</td>
<td>Revenue ($)</td>
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<tr>
<td>Lighting</td>
<td>124,606</td>
<td>425.2</td>
<td>$17,694</td>
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<tr>
<td>Occupancy Sensors</td>
<td>30,358</td>
<td>103.6</td>
<td>$4,311</td>
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<tr>
<td>Vending Machines</td>
<td>4,205</td>
<td>14.3</td>
<td>$597</td>
</tr>
<tr>
<td>New Slurry Pumps</td>
<td>684,093</td>
<td>2,334.1</td>
<td>$96,947</td>
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<tr>
<td>Parlor Vacuum Pumps VFD</td>
<td>98,856</td>
<td>337.3</td>
<td>$13,840</td>
</tr>
<tr>
<td>Special Needs Vacuum Pumps VFD</td>
<td>3,684</td>
<td>12.6</td>
<td>$523</td>
</tr>
<tr>
<td>Calf Barn &amp; Old Milk Hse Water Heaters</td>
<td>66,334</td>
<td>226.3</td>
<td>$4,660</td>
</tr>
<tr>
<td>Liquid Propane Energy Source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy (Gallons)</td>
<td>Energy (MMBtu)</td>
<td>Revenue ($)</td>
</tr>
<tr>
<td>New Pre-Heaters</td>
<td>2,110</td>
<td>193.0</td>
<td>$4,220</td>
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<tr>
<td>Parlor Tankless Water Heater</td>
<td>505</td>
<td>46.2</td>
<td>$1,009</td>
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<tr>
<td>Calf Barn &amp; Old Milk New Water Htrs</td>
<td>(2,380)</td>
<td>(217.7)</td>
<td>($4,759)</td>
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<tr>
<td>Hot Water Pipe Insulation</td>
<td>1,024</td>
<td>93.7</td>
<td>$2,048</td>
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<tr>
<td>Energy Star Washing Machine</td>
<td>110</td>
<td>10.1</td>
<td>$221</td>
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<tr>
<td>Totals - Electricity &amp; Liquid Propane</td>
<td>3,578.7</td>
<td>$141,311</td>
<td>$248,739</td>
</tr>
</tbody>
</table>
## Energy Conservation Measures

<table>
<thead>
<tr>
<th>Natural Gas Systems</th>
<th>Natural Gas Usage</th>
<th>Energy Cost ($/yr)</th>
<th>(MCF/Year)</th>
<th>(MMBtu/Yr)</th>
<th>Energy Savings/Year (MMBtu)</th>
<th>Revenue ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big House - Existing</td>
<td>No Energy Curtains</td>
<td>$29,542</td>
<td>3,555</td>
<td>3,555</td>
<td></td>
<td></td>
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<tr>
<td>Big House - With Energy Curtains</td>
<td></td>
<td>$17,268</td>
<td>2,078</td>
<td>2,078</td>
<td>1477.0</td>
<td>$12,274</td>
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<tr>
<td>Quonsets 2, 3 &amp; 4 Existing Unit Heaters</td>
<td></td>
<td>$7,087</td>
<td>853</td>
<td>853</td>
<td></td>
<td></td>
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<td>Quonsets 2, 3 &amp; 4 New Unit Heaters</td>
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<td>$5,837</td>
<td>702</td>
<td>702</td>
<td>150.4</td>
<td>$1,250</td>
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<tr>
<td>Quonsets 2, 3 &amp; 4 Existing Conditions</td>
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<td>$7,087</td>
<td>853</td>
<td>853</td>
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<tr>
<td>Quonsets 2, 3 &amp; 4 With Weatherization</td>
<td></td>
<td>$6,535</td>
<td>786</td>
<td>786</td>
<td>66.4</td>
<td>$552</td>
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<table>
<thead>
<tr>
<th>Electricity System</th>
<th>Electricity Savings/Year</th>
<th>Cost ($/yr)</th>
<th>(kWh/yr)</th>
<th>(MMBtu/Yr)</th>
<th>Energy (MMBtu)</th>
<th>Revenue ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Lighting</td>
<td></td>
<td>$1,191</td>
<td>8,952</td>
<td>30.5</td>
<td></td>
<td></td>
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<tr>
<td>Proposed Lighting</td>
<td></td>
<td>$311</td>
<td>2,337</td>
<td>8.0</td>
<td>22.6</td>
<td>$880</td>
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</table>

**Totals - Natural Gas & Electricity Systems**

1,716.4

$14,956
# AC Energy & Cost Savings

<table>
<thead>
<tr>
<th>Station Identification</th>
<th>Results</th>
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<tbody>
<tr>
<td><strong>Cell ID:</strong> 0245365</td>
<td><strong>Month</strong></td>
</tr>
<tr>
<td><strong>State:</strong> Michigan</td>
<td>1</td>
</tr>
<tr>
<td><strong>Latitude:</strong> 42.8 ° N</td>
<td>2</td>
</tr>
<tr>
<td><strong>Longitude:</strong> 86.1 ° W</td>
<td>3</td>
</tr>
<tr>
<td><strong>PV System Specifications</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>DC Rating:</strong> 20.0 kW</td>
<td>5</td>
</tr>
<tr>
<td><strong>DC to AC Derate Factor:</strong> 0.770</td>
<td>6</td>
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<tr>
<td><strong>AC Rating:</strong> 15.4 kW</td>
<td>7</td>
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<tr>
<td><strong>Array Type:</strong> Fixed Tilt</td>
<td>8</td>
</tr>
<tr>
<td><strong>Array Tilt:</strong> 42.8 °</td>
<td>9</td>
</tr>
<tr>
<td><strong>Array Azimuth:</strong> 180.0 °</td>
<td>10</td>
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<tr>
<td><strong>Energy Specifications</strong></td>
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<tr>
<td><strong>Cost of Electricity:</strong> 13.7 ¢/kWh</td>
<td>12</td>
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<tr>
<td><strong>Year</strong></td>
<td>4.10</td>
</tr>
</tbody>
</table>


Qualifies for Funding $

• Grants, Low-Interest Loans
• USDA Rural Development
  • Rural Energy for America Program (REAP)
  • Funding Through FY 2018
  • Competitive Application Process
• USDA Natural Resources Conservation Services (NRCS)
• MEDC (MI Economic Dev. Corp.)
• Michigan Saves
Qualifies for Funding $

• Utility Company Incentives
  • Consumers Energy
  • DTE Energy
  • Other utility companies
• Federal & State Incentives
  • Tax Credits
  • Accelerated Depreciation
How is an Energy Audit or Renewable Assessment Completed?

• Contact MSU or Certified Energy Auditor
• Schedule On-site Review Date
• Information List Provided in Advance
• Site Review with Owner/Operator – 3 to 4 Hours
• Acquire Site-specific Information, Energy Data & Understanding of Operation
• Proposed Improvements Information
How is an Energy Audit Completed?

- Minimum Fee
- Reimbursement from some Utilities
- Energy Audit Review with Owner
- Owner Acknowledgement – MSU Program Reimburses Certified Energy Auditor
MSU Contact

- **Aluel S. Go** - Biosystems & Agricultural Engineering Michigan State University
  - East Lansing, MI 48824-1323

- (517) 214-6128 (Aluel Go)

- MSU Farm Energy website: maec.msu.edu/farmenergy/
QUESTIONS?

Dan Schrauben
Schrauben Associates, LLC
MSU Certified Farm Energy Auditor
Cell: 810 602 3029
schraubend@comcast.net