Agricultural Energy Management Plan – (Landscape AgEMP)
Conservation Activity Plan Code (124) (No.)

1. Definition

A **Landscape AgEMP** is a detailed report documenting the energy consuming components and practices of the current operation's on-farm field energy consumption involved in the cropland, pasture/hayland, range, and woodland activities with recommended strategies to conserve energy resources. This Landscape AgEMP does not involve energy use on the farm headquarters area. The results of this Landscape AgEMP will provide strategies by which the producer will explore and address their on-farm energy conservation concerns, objectives, and opportunities.

2. Landscape AgEMP Criteria:

This section establishes the minimum criteria to be addressed in the development of an Agricultural Energy Management Plan (Landscape AgEMP) for the Landscape portion of the farming operation (cropland, pasture/hayland, range, and woodland).

1. **General Criteria:** The Agricultural Energy Management Plan (Landscape AgEMP) shall be developed by a certified Technical Service Provider (TSP). In accordance with Section 1240 (A) of the 2008 Farm Bill, the Environmental Quality Incentives Program (EQIP) provides funding support through contracts with eligible producers to obtain services of certified TSPs for development of a Landscape AgEMP. The TSP proficiency criteria required to develop an Landscape AgEMP for an EQIP eligible producer is located on the TSP registry (TechReg) web site at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/tsp

2. **Criteria for Specific Elements of the Landscape AgEMP**

   1. The Landscape AgEMP will meet the Type 2 on-farm energy audit minimum criteria established in the ***ANSI/ASABE S612 July2009 Performing On-farm Energy Audits*** **(attached)** standard, hereafter referred to as the industry standard.
   2. **Background and Site Information** – The Landscape AgEMP shall include:
      a. Name of producer
      b. Farm(s) location(s)
      c. A narrative describing the type and size of the operation (e.g., cropland, irrigation, pasture/hayland, range, forest) and any unusual factors that affect energy use)
      d. A narrative describing the producer's concerns, objectives, opportunities, and overall management scheme for the enterprise (i.e., description of why the producer wants an on-farm energy audit and their specific objectives).
   3. **Documentation of Baseline Current Energy Use**: The Landscape AgEMP will provide comprehensive documentation of the current energy resources (e.g., electricity, natural gas, diesel, gasoline, etc.) used for all the equipment used in the field on the producer's entire farming enterprise, respective total current energy usage, and total cost data. The evaluation of current energy use shall address the current energy use for engine driven equipment used in the cultivation, irrigation (to include a pump test), drainage (to include a pump test, if applicable), protection, and harvesting of agricultural commodities associated with the field production activities. This does not address energy associated with inputs such as fertilizers and pesticides, etc. A comprehensive summary of all of the above items will be presented by each energy resource. In addition to the above comprehensive landscape energy baseline, the Landscape AgEMP will document the major activities associated with each of the producers entire agricultural enterprise:

      a. Components/details of the major activities, as appropriate and primary equipment:
         - Manufacturer of equipment,
         - Equipment component factory ratings (hp, efficiency, BTU input and BTU output)
         - Management use efficiencies (e.g. manual/automatic systems)

b. Annual energy use

NOTE: If a major activity is not applicable to the farm enterprise or the major activity has no opportunities for improved energy use, the report needs to state this.

4. **Recommended Measures/Conservation Practices**: The Landscape AgEMP will provide appropriate energy savings for each major item of equipment/activity (including a comparison to the baseline energy use) that reduces energy use and addresses the energy management needs for the entire agricultural operation (see ASABE S612 Table 1).
   a. The recommended measures for energy improvement are to be presented.
   b. Estimated energy savings are to be presented. . For each measure examined, the report must present:
      1) The estimated energy savings—first in the common sale units (kWh, gallons, etc.) and secondly in the energy units of millions of British Thermal Units (mBTU);
      2) the estimated energy cost savings;
      3) the estimated installed cost;
      4) the simple payback period in years;
      5) the estimated reductions in emissions with specific estimates for CO_2, N_2O, CH_4, SO_2, and NO_X. (Guidance on how to calculate greenhouse gas emission reductions and air pollutant co-benefits is provided in Appendix A); and
      6) equipment product information associated with recommendations and/or comparisons of specific products. (Provide size, model numbers here; specifications, more detail, etc. can be provided in references.)
   c. Estimated cost and energy cost savings in years are to be presented.
   d. Simple payback period (in years) shall be documented for each of the recommended energy improvement measures.
   e. The plan may include, but is not limited to, the conservation practices listed below:
      - Conservation Crop Rotation (328)
      - Residue and Tillage Management, No-Till/Strip Till/Direct Seed (Ac.) (329)
      - Residue and Tillage Management, Mulch Till (Ac.) (345)
      - Irrigation System, Micro-irrigation (441)
      - Irrigation System, Sprinkler (442)
      - Irrigation Water Management (449)
      - Pumping Plant (533)
   f. The plan may include, but is not limited to the following recommended energy improvement measures: GPS guidance systems, sensors, control systems, variable drives, compressors, motors, waterers, planting, tilling, harvesting, engine driven equipment. (Refer to Table 1 in the ASABE S612 industry standard, for more information on the components listed for each of the major energy activity categories)

5. **Summary Reporting of Recommended Measures**: The following table and its format must be provided at the beginning of the Landscape AgEMP report. The summary table (shown below) will contain each of the various recommended measures, prioritized according to pay-back period.
   a. Estimated reduction in energy use (electricity, propane, diesel, etc.), estimated energy savings, estimated installation cost, and estimated energy cost savings.
   b. The payback in years column determines the sequence in which recommended measures are to be listed in the summary table. This sequence can be used to provide guidance on the recommended sequence of implementation, from shortest time of payback to longest time of payback.
   c. Recommended measures with payback periods exceeding 10 years may be presented in the body of the report but shall not be included in the Summary of Recommendations.

SUMMARY OF RECOMMENDATIONS

Table 1 below contains a summary of the recommended energy improvement measures for a farming operation. Energy efficient equipment lowers costs by performing the same or more work with less energy.

Table 1. Summary of Estimated Annual Energy Efficiency Improvements

	Estimated Reduction in Energy Use					Estimated Costs, Savings, Payback, and Prioritization for Implementation			Environmental Benefits [1]				
Recommended Measure	Electric Savings (kWh)	Propane Savings (Gal)	Nitrogen Savings (lbs.)	Other 2/	Energy Savings 1/ (MMBTU)	Installed Cost [$]	Energy Cost Savings [b]	Payback in Years [a / b]	CO_2 (lbs.)	N_20 (lbs.)	CH_4 (lbs.)	$S0_2$ (lbs.)	$N0_X$ (lbs.)
Example: Red Clover Cover Crop			370,365	Diesel Increase (Gal) (-1,481)	7,201	$116,028	$151,849	0.76	N/A	N/A	N/A	N/A	N/A
Example: Strip Tillage			59,146	Diesel Savings (Gal) 10,815	2,687	0	$62,149	0	242,006	5.35	30.04	3.08	194.67
Totals			429,511	9,334	9,888		$213,998						

Note 1. Environmental Benefits are reduction estimates, values are per http://cometfarm.nrel.colostate.edu/, which does not quantify nitrogen savings values

Table 1 Notes:

1) The estimated energy and cost savings are approximate values provided from an actual on-farm energy audit.
2) Other: Gasoline, Diesel fuel, Natural Gas

Energy Savings as a percent of total energy usage will also be presented for each energy type as shown in the following Table 2 example.

Table 2. Energy Savings of Recommendations

Fuel	Current Usage	MBtu Usage	Savings	MBtu	% Savings
Diesel (gallons)	61,781	8,5888	9,334	1,297	15.5%
Nitrogen Fertilizer (Lb N)[1]	985,766	19,715	429,511	8,590	43.6%
Totals		**28,303**		**9,888**	**34.9%**

Note: 1. Energy equivalent of nitrogen fertilizers is assumed to be 20,000 Btu/lb, per NRCS Practice Standard 124.

6. **References**: The Landscape AgEMP shall include technical documentation of sources used for the Landscape AgEMP. Include the actual documents or web sites that contain the technical documentation useful for the producer such as:
   a. Fact sheets
   b. Product information
   c. Recommendations and or comparisons of specific products
   d. Journal articles
   e. Manufacturer product information sheets, etc.

7. **Definitions:**

   a. Energy: Fuels (propane, diesel, natural gas, etc.) and electricity used to perform stationary farm and ranch activities.

   b. On-Farm Energy Auditor: A person who has the technical qualifications to perform an agricultural energy audit.

   c. Energy Type: The type of fuel (liquid or gas), electricity, etc. used to perform farm and ranch activities.

   d. Current Energy Usage: The annual usage of energy (electricity, natural gas, other fuels, etc.) for stationary farm or ranch operations.

3. Deliverables for the Client – a hardcopy of the Landscape AgEMP shall include:

a. The Cover page of the Landscape AgEMP will contain the following:

- Name and address of Producer and TSP,
- Date Landscape AgEMP was performed,
- Signature blocks for the TSP and producer, and
- Signature and date block for the NRCS Field Office concurrence.

b. The Landscape AgEMP Document

- Farm location(s) map
- Type and size of the operation (e.g., cropland, irrigation, pasture/hayland, range, forest) and any unusual factors that affect energy use)
- Producer concerns, objectives, opportunities, and overall management scheme for the enterprise (i.e., description of why the producer wants an on-farm energy audit and their specific objectives)
- Documentation of Baseline Current Energy Use
- Recommended Measures/Conservation Practices
- The summary tables (Table 1 and Table 2) will contain each of the various recommended measures, prioritized according to pay-back period, and estimated energy savings.
- Recommended measures with payback periods exceeding 10 years may be presented in the body of the report but shall not be included in the Summary of Recommendations.

4. Deliverables for NRCS Field Office:

Complete Hardcopy and Electronic copy (MS Word) of the completed Landscape AgEMP.

Attachment: ANSI/ASABE S612 JUL2009, Approved July 2009 as an American National Standard

APPENDIX A

ENVIRONMENTAL BENEFITS

Guidance on how to determine values for greenhouse gases and air pollutant co-benefits environmental benefits.

In order to estimate the environmental benefits associated with estimated energy savings, NRCS has developed a Quick Energy calculator that transforms energy saving measures for fuels and electricity into atmospheric emission reductions. The Quick Energy Tool relies on EPA's state- level aggregated emission factors for electricity, to generate estimates of emissions savings for electricity. The Quick Energy Tool relies on the EPA Energy Information Agency's emission factors for liquid and gaseous fuels, to generate estimates of emissions savings for liquid and gaseous fuels.

The Web link to the NRCS COMET Quick Energy Calculator for converting Energy Savings into Emissions Reductions is located at: http://www.comet2.colostate.edu/

Performing On-farm Energy Audits

Developed by ASABE with the cooperation of USDA NRCS. Approved by cross division representation of the society under the guidance of T-11, Energy, and approval of T-01, Standards (Policy & Adoption). Adopted July 2009. Approved by ANSI July 2009.

Keywords: Audit, Costs, Efficiency, Energy, Management

1 Purpose

1.1 This Standard establishes procedures for performing on-farm audits 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. This Standard is provided to guide the reporting of data and the preparation of specific recommendations for energy reduction and conservation with estimates of energy savings.

Scope

2.1 This Standard is intended to support energy audits of all types of farming operations (which includes ranching) typically found in North America. Energy audits shall exclude the farm residence, except where it is not practical to separate base line data.

2.2 This Standard does not address secondary (off-farm) energy savings in the development and evaluation of alternatives. For example, reduction in the amount of fertilizer used on a farm would represent a reduction of the associated energy needed to produce fertilizer for the farm at a fertilizer production facility (off-farm). This type of energy savings is not addressed as a part of this Standard.

3 Definitions

3.1 Energy: For the purposes of this Standard energy is the resource used to power equipment to do mechanical work or to generate heat, light or cooling.

3.2 Energy resource: Source from which energy is obtained, including gasoline, diesel fuel, biofuel, propane, natural gas, electricity, solar, wind, wood, biomass, geothermal, etc.

3.3 Farm enterprise: Production category of a farm. For example, a farm may include a field crop enterprise and a livestock enterprise. (See Table 1)

3.4 Major activity: A discrete activity associated with a farm enterprise that utilizes an energy resource, or that heavily impacts energy resource use. For example, a cropping enterprise may include grain drying, crop planting, tilling, and harvesting activities. (See Table 1)

3.5 Component: Individual parts of a major activity. For example:

Lighting systems include lamps, ballasts, timers, sensors, etc. (See Table 1)

3.6 Energy auditor: A licensed professional engineer or other technically qualified individual who will certify that the audit report provided to the farmer/rancher meets the requirements outlined in ASABE S612.

3.7 Management operation Describes the specific routine and timing of tasks that would allow someone to understand how the farm/ranch runs an enterprise on a day to day basis.

3.8 Management scheme A general overview of the enterprise, what it consists of, future plans, and any other factors that influence the overall operation of the farm. For example, a free-stall dairy operation with 150 milking cows, etc.)

3.9 Type 1 Audit: An evaluation and report of farm enterprise energy use that considers, at a minimum, the major activities highlighted in Table 1, as applicable. A Type 1 Audit is not required to address individual components.

3.10 Type 2 Audit A more detailed evaluation and report of farm enterprise energy use that considers all major activities and components included in Table 1, as applicable.

4 Documenting the base-line condition

4.1 This section specifies the procedure for developing a record of a farm's energy use over the past annual cycle.

4.2 For each of the audited farm enterprises describe:

4.2.1 Overall management scheme for the enterprise.

4.2.1.1 Address enterprise specific management operations as required by the audit type.

4.2.1.2 Acquire from operator energy use and cost data for most recent

12 month period.

4.2.2 Major activities associated with the enterprise.

4.2.2.1 Describe activity and primary equipment involved.

4.2.2.2 For each major activity, document type of energy resource used and current energy consumption. Also, as appropriate, electrical service information (single or three phase; voltage) (natural gas or propane) needs to be included.

4.2.2.3 Describe components of major activities, as appropriate/available, (required for Type 2 only).

4.2.2.3.1 Manufacturer of equipment

4.2.2.3.2 Component factory ratings (hp, efficiency, Btu input, and Btu output)

4.2.2.3.3 Management use efficiencies (are manual systems in place that could be automated or timed)

4.2.2.3.4 Annual energy use

4.3 Summarize by energy resource

5 Assessment and Recommendations

5.1 This section specifies how recommendations shall be presented and minimum information needed to be provided consistent with audit type (see paragraphs 3.9 and 3.10).

5.2 Energy savings at the enterprise level shall be reported in units useable and understandable by the end-user (J, Btu, kWh).

5.3 Appropriate energy savings recommendations shall be made for each major activity including a comparison to the base-line condition for:

5.3.1 Estimated cost of replacement/upgrade equipment.

5.3.2 Estimated savings in energy and energy cost, including appropriate assumptions and documentation.

5.3.3 Estimated simple payback period (in years) for implementing each recommendation.

6 Certifications

6.1 All audit reports shall contain a certification statement that the auditor(s) possess the technical expertise and experience to perform on-farm energy audits, and that the audit report meets all requirements in ASABE Standard S612. (See informative annex A.)

Table 1 – Suggested Components within Major Activities by Farm Enterprises for Audit Assessment

Farm Enterprises

Major Activity	Components	Dairy	Swine	Poultry	Beef/ veal	Field crops	Fruit/ vegetables	Aquaculture	Nursery/ Greenhouse
Lighting[1,7,10]	lamps, timers, sensors	X[6]	x	x	x		x	x	X
Ventilation[2,7,10,11] drives, humidity control	fans, control system, variable	x[6]	x	x	x		x	X(aeration)	x[8,9]
Refrigeration[5,7,10] motor, insulation	compressor, evaporator/chiller,	milk, products[6]		eggs			commodity	x	Veg/cut flowers
Milk harvesting[7,10]	pumps, motors, controllers	x[6]							
Controllers[7,10]	master system automation	x	x x	x x				x x	x x
Other motors/ pumps[3,4,7,10]	Types, compressors	X[6]			x	x	x		
Water heating[7,10,12]	heater, energy source, insulation, recovery, waterers	x[6]	x	x	x				
Air Heating/ Bldg environment[10]	heater, energy source, insulation, recovery, variable drives	x	x	x	x		x		x[8,9]
Drying[10]	energy source, airflow (motors/fans), handling equipment					x			
Waste handling	collection and dispersal equipment/methods	x	x	x	x			x	
Air Cooling	energy source, airflow (motors/fans), control systems, evaporative	x	x	x	x				x[8,9]
Cultural Practices	planting, tilling, harvesting, engine driven equipment					x	x		
Crop/feed Storage					x	x	x	x	x
Water management	wells, reservoir, recycled	x	x	x	x	x	x	x	x
Material handling[7,10]	equipment, motors, pumps	x[6]	x	x	x	x	x	x	x
Irrigation[10]	motors/engines, pumps, power source					x	x		x

Footnotes:

Listed references are guidance documents or tools useful for assessing the energy use and/or efficiency associated with various major activities and/or farm enterprise. Not included here are the numerous planning guides that address the design of farm enterprise systems and the major activities involved because most do not directly assess energy conservation or efficiency. These planning and design guides provide a reference for understanding elements of efficient production systems, but do not specifically address energy use or efficiency as is the intent of this standard. These are by no means the only guides and tools that can be used in performing these audits.

1. ASABE Standards. 2009. EP344.3: Lighting systems for agricultural facilities. St. Joseph, Mich.: ASABE.
2. ASABE Standards. 2008. EP566.1: Guidelines for selection of energy efficient agricultural ventilation. St. Joseph, Mich.: ASABE.
3. Srivastava, Ajit K., Carroll E. Goering, Roger P. Rohrbach, and Dennis R. Buckmaster. 2006. Chapter 3: Electrical power for agricultural machines.In Engineering Principles of Agricultural Machines, 2nd ed., 45–64. St. Joseph, Mich.: ASABE.
4. Gustafson, Robert J., and Mark T. Morgan. 2004. Chapter 8. Electric motors. In Fundamentals of Electricity for Agriculture, 3rd edition, 205–248. St. Joseph, Mich.: ASAE.
5. Peebles, R.W., D. J. Reinemann, R. J. Straub. 1994. Analysis, of milking center energy use. Applied Engineering in Agriculture 10(6): 831–839.
6. Go, A. and Surbrook, T. 2009. Michigan dairy farm energy audit guide. East Lansing, Mich.: Michigan State University, Departments of Biosystems & Agricultural Engineering, Food & Resource Economics. Available at: http://web5.anr.msu.edu/fa/farm%20energy%20calculators.html.
7. UW-Madison. 2009. Farm energy assessment toolkit. Madison, Wisc.: University of WI-Madison and Wisconsin Focus on Energy. Available at: http://www.soils.wisc.edu/foe/login?resource=%2Ffoe%2Flogin%20.
8. ASABE Standards. 2009. EP460: Commercial greenhouse design and layout. St. Joseph, Mich.: ASABE.
9. ASABE Standards. 2008. EP406.4: Heating, Ventilating, and Cooling Greenhouses. St. Joseph, Mich.: ASABE.
10. Sanford, S., et al. 2009. Energy Self-Assessment tools, University of Wisconsin-Madison, Available at: http://www.ruralenergy.wisc.edu/.
11. UI-Urbana-Champaign. 2009. Agricultural Ventilation Fans—Performance and Efficiencies, Bioenvironmental and Structural Systems Laboratory (BESS Lab), University of Illinois-Urbana-Champaign. Available at: http://www.bess.uiuc.edu/.
12. Directory of Certified Product Performance. 2008. Gas Appliance Manufacturers Association, Available at: http://www.ahridirectory.org/ahridirectory/pages/home.aspx.

Annex A (informative) Commentary

This Annex provides additional information and explanation of considerations used in developing this Standard.

Documentation: The Standard provides flexibility in how audit reports are developed and documented. The Standard only addresses the minimum requirements for documentation that would provide for sufficient information from which the farm operator could make informed decisions. However, greater documentation is encouraged to provide as complete a supporting case file as is practical. This documentation may not be included in the report provided the farm operator, but should be maintained in a case file. It is suggested that for each alternative major activity component an appropriate reference be included that would support recommendations for improving energy efficiency.

Assessments: In determining the economy of various energy use activities on a farm, it is important to consider potential increases in product as part of the benefit used in the analysis. It is recognized that sometimes an increase in energy use will facilitate greater production on-farm (i.e., larger ventilation fans in poultry houses, that provide for healthier bird production), thereby increasing the benefit to cost relationship. Therefore, it could be appropriate to consider these factors in the energy use assessment and determinations of changes in efficiency. This evaluation is sometimes referred to as ''energy density unit calculations.'' Also, it was assumed in the crafting of paragraph 5.3.2 that changes in energy management (i.e., timing of power demand to off-peak times; or sequential starting of large motors) should be addressed as a ''savings of energy cost'' even though it does not necessarily represent a saving in overall energy consumption. Furthermore, it is recognized that the standard does not identify specific procedures for performing various audit functions associated with the major activities and their associated components. Other standards exist that provide this function, that were too numerous to reference specifically; however, it is recommended that recognized standards (ASABE, AWWA, ASTM, etc.) be used whenever possible.

Renewable Energy: The developers of this Standard recognize that in some situations conversion to a renewable energy resource may be a practical alternative to present to a farm operator. It is also recognized that the use of renewable energy resources should be encouraged whenever possible. However, the intent of this Standard is not to facilitate a reduction in non-renewable energy resources, but rather to provide a method to facilitate increased efficiency in the use of whatever energy resources are being used.

Certification: Ideally, there would be a process in-place, provided by non-profit, State, or National entities, for certification of on-farm energy auditors. This certification could be referenced as a requirement for performing on-farm energy audits to add credibility to individuals wishing to perform such audits. There are certifications and licensing processes that do provide a level of assurance that an individual is qualified, if only ethically bound, to perform the audits described in this Standard, such as licensed engineers, Association of Energy Engineers (AEE)—Certified Energy Managers (CEM), the Association of Energy Engineers—Certified Energy Auditor (CEA), or state certified/licensed farm energy auditors.

Commentary on Table 1: Table 1 contains a listing of the most common major activities and their most often associated components found on- farm for various farm enterprises. As a minimum for a Type 1 audit, it is expected that each of the major activities highlighted for a specific enterprise will be addressed, as a whole, in the assessment and report. The highlighted major activities are those assumed to address the most likely opportunities for improving energy use efficiency on a typical farm operation. For the more comprehensive Type 2 audit, it is intended that for all applicable major activities, each component type found on the farm would be addressed.

Support facilities such as farm shops and offices are not addressed specifically in the Standard; however they should be included in the various major activities assessed within an enterprise.