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Performing On-farm Energy Audits



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Performing On-farm Energy Audits

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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.)

ATTACHMENT B

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

Major Activity	Components	Farm Enterprises							
		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}	fans, control system, variable drives, humidity control	x ⁶	x	x	x		x	X(aeration)	x ^{8,9}
Refrigeration ^{5,7,10}	compressor, evaporator/chiller, motor, insulation	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
Other motors/pumps ^{3,4,7,10}	Types, compressors	X ⁶	x	x	x	x	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.

- ASABE Standards. 2009. EP344.3: Lighting systems for agricultural facilities. St. Joseph, Mich.: ASABE.
- ASABE Standards. 2008. EP566.1: Guidelines for selection of energy efficient agricultural ventilation. St. Joseph, Mich.: ASABE.
- 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.
- 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.
- Peebles, R.W., D. J. Reinemann, R. J. Straub. 1994. Analysis, of milking center energy use. *Applied Engineering in Agriculture* 10(6): 831–839.
- 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>.
- 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>.
- ASABE Standards. 2009. EP460: Commercial greenhouse design and layout. St. Joseph, Mich.: ASABE.
- ASABE Standards. 2008. EP406.4: Heating, Ventilating, and Cooling Greenhouses. St. Joseph, Mich.: ASABE.
- Sanford, S., et al. 2009. Energy Self Assessment tools, University of Wisconsin-Madison, Available at: <http://www.ruralenergy.wisc.edu/>.
- 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/>.
- 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.