

The Michigan Farm Energy Audit Technical Writing Guide

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Acknowledgement

The analyses are based on technical sources which include “The Michigan Farm Energy Audit Technical Guide”, Michigan State University, Biosystems & Agricultural Engineering Department, and input from the owners and others such as other educational institutions, equipment suppliers and suppliers specific to their field and product.

Energy savings presented in this document are estimates and are based upon information gathered during the process of conducting this energy audit. Actual savings may vary from estimated savings due to a variety of factors including changes in energy usage and energy costs. Numbers presented in this document may not add up precisely due to rounding. Equipment costs presented in this document are estimates and are based upon available pricing information. Actual costs may vary from estimated costs due to variables such as product availability and geographic location.

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Table of Contents

Acknowledgement	i
Introduction	1
Technical Writing	2
Language.....	3
Flow	3
Grammar	5
Parallel Structure.....	5
Subjects and Verbs.....	5
Active and Passive Voice.....	6
Numbers as Words	6
Numbers as Digits.....	7
Citation.....	8
Review	9
ASABE Standards.....	10
Introduction.....	10
Documentation.....	10
Assessment and Recommendation.....	11
List of Possible Activities	11
Definitions.....	12
Formatting	13
Subject Order	13
Cover Page.....	14
Table Formatting.....	14
Headings	15
Body Text.....	15
Header/Footer	15
Appendix	15
Resources	16
References	16

Introduction

The purpose of this technical writing guide is to educate and create consistency with the program. Topics in this guide include technical writing styles, ASABE standards, and optimized formatting for specific audiences. The guide will address “how” and “what” to write.

Technical writing style is a professional style of writing with the goal of being informative among other characteristics. One important aspect of this technical include understand the reader’s technical background. Writing to the reader’s skill level helps convey the critical data or recommendation along with the rational. If the reader cannot understand the report, they will lose all the benefits.

Understanding American Society of Agricultural and Biological Engineers (ASABE) standards is crucial for the legitimacy of the report. Without meeting the requirements the report is not acceptable. The standards address the areas for examination and how to approach reviewing and reporting the gathered data.

Formatting is key for communicating the data, results, and recommendations. The way information is conveyed is part of the effectiveness. Poor formatting discourages comprehensive reading. Good formatting encourages detailed evaluation and promotes professionalism. Collectively, uniform formatting among all reports demonstrations legitimacy and professionalism.

Michigan Energy Audit Program provides other resources for a better energy audit report and client experience. Utilize all the available tools for help. Any questions can be directed to the website or through phone or email. This information will be detailed at the end of the guide.

Technical Writing

Technical writing is informative, accurate, complete, clear, and concise language written specifically for an identified audience. The content must be accurate and complete with no exaggerations. To deliver the intended message, the text must be objective and persuasive without being argumentative. Developing technical documents that meet these requirements and standard guidelines is time consuming. This section provides an overview of those standards and a process to create interesting, informative text.

Before composing the text, identify the audience, determine the message, collect adequate information, brainstorm, and then develop a detailed outline. Details of each process are provided below.

1. Identify the audience by answering the following questions:

Who is the intended audience (one or multiple)?

What subject knowledge, vocabulary, and biases will the intended audience have?

How will the report be used?

What information must be conveyed and how much detail will be expected?

2. Determine the purpose of the report by evaluating the intended message. A clear message will help focus on what to include and what to discard.
3. Collect adequate relevant information with sufficient depth for the intended audience before starting to write.
4. Brainstorm by listing relevant ideas. Then group related thoughts together. Organize the key points and supporting details in a logical order. Ensure that each section relates to and supports the message, eliminating irrelevant ideas.
5. Develop an outline of heading and subheadings that convey key points; for example, use *Analytic Results of Energy Production* in place of *Results*. Then assign a length to each topic.

Next, develop figures and tables. Then begin writing, remembering to maintain consistency and use appropriate language. Create interesting text by developing coherent paragraphs that incorporate transitional words and sentence variety. Use correct grammar and punctuation.

Language

Formal English is explicit even for the foreign reader who uses English as a second language. This requires elimination of contractions (I'm, don't) and personal pronouns, which include: first person (e.g., I, we, our, us); second person (you, your, yours); and third person (he, her, it, theirs). Eliminate words with multiple meanings (e.g., feel, handle, run) to assist with comprehension, especially by foreign readers. Technical text is also void of colloquialisms, jargon, clichés, and sexist language – each of which is defined in detail below.

Colloquialisms (local or regional expressions) are characteristic of ordinary spoken or written communication that imitates informal speech, which may not carry the expected meaning. Examples include “gonna” for “going to” and “passed on” for “died.”

Jargon, or slang, is terminology that is used by a particular group of people in a specialized field; it may not be understandable by another group or individual. If jargon is used, define or explain the meaning.

For example, a “hydrostat transmission” is jargon for a “variable pump hydraulic transmission with infinite speed variability.” Examples of slang include “hang on” for “wait” and “run” for “computer simulation.”

Clichés, when first created, were vivid descriptions of something that was current in the minds of the people. As time passed, the descriptions lost their original meaning, and no longer represent descriptive text (e.g., avoid like the plague; a can of worms; in the long run; and by the same token). Technical writing must also be void of recent and current clichés.

Sexist language is inappropriately gender specific. To prevent bias, eliminate gender specific words to describe a category of people who could be either male or female. Do not use adaptations, such as he/she, because they hinder the text flow. As alternatives, use plurals, change words, or simply say he and she, his or her, him and her.

Flow

Select an appropriate style and tone, and then simply write down ideas and facts without concern for quality or format under each heading and subheading. Then edit, wait, and edit again, eliminating irrelevant information, emotion, unsupported opinions, and judgments.

Organize the ideas into smooth flowing text by developing coherent paragraphs, using transitional words, and incorporating sentence variety. Be selective in the use of acronyms and initialisms. Use numbers or bullets to convey lists of information.

Create paragraphs with a single topic or focus, and include supporting details. Each paragraph usually contains around five sentences (although this is not a rule). To improve comprehension, place the key topic at the beginning of a sentence and new information at the end.

All of the ideas contained within a paragraph must relate to one central thought. Arrange factual sentences in a logical order from general to specific. If there are ideas that relate to other foci, construct additional paragraphs.

In order to build the individual paragraphs into a complete paper, take ideas from the beginning paragraph and expand each into subsequent paragraphs. Link paragraphs together by stating what will appear in the next paragraph.

Use transitional words to connect one idea to the next, one sentence to another, one paragraph to another. Forms of transitional words include: connectors (but, subsequently, then, besides, furthermore, similarly, likewise, in which, nevertheless); indicators for time order (earlier, later); position in time (rarely); sequence (next); compare/contrast (also/but); the end of an idea (finally); conclusions (in conclusion); causality (because, as a result, therefore).

Create smooth flowing interesting text by varying the length and type of sentences. Eliminate repeated words in a single sentence and vary the beginning word of sentences within a paragraph. Avoid very short sentences and long (run-on) sentences unless both the meaning and logical relationships between multiple clauses are clear. Combine sentences to eliminate redundancy and improve text flow.

Avoid using phrases with more than three nouns in a row by dividing the phrase into a shorter noun phrase with a relative clause or prepositional phrase, or use hyphens to connect closely related words in the noun string. Compare the first example, which has six nouns in a row, with the rewritten sentence that follows:

The nanotechnology enhanced iron foam column contactor removes phosphorus ...

The column contactor uses nanotechnology-enhanced iron foam to remove phosphorus ...

For clear text that is understandable for non-native English-speaking readers, use simplified verb phrases and tenses. The sentence:

Fabricated steel components should not be welded by beginning students.

Could be written as

Beginning students should not weld fabricated steel components. (Simplified)

Locate previously introduced information in the topic (subject) position of the next sentence to assist with comprehension.

Bob called the dog. The dog stopped immediately.

When using prepositional phrases, make sure it is obvious what each preposition is modifying.

The news report stimulated conversation, but this did not resolve the problem.

(Does *this* refer to the news report or the conversation?)

Avoid ending a sentence in a preposition by selecting a more descriptive action verb.

The burglar finally gave up. The burglar finally surrendered.

Use the following diverse sentence structures to provide variety. Simple sentence: Includes subject-verb-object, in that order.

The laboratory report summarized the results.

Compound sentence: A subordinate clause appears before the main clause.

If you find the answer, it will relieve everyone in the class.

Complex sentence: Consists of an independent clause followed by an independent clause

The final reports were due yesterday, and no one knew who had the original.

Compound/complex sentence: An independent clause is preceded or followed by a subordinate clause and then a second independent clause.

If you find the answer, it will relieve everyone in the class; admiration from all is a nice reward.

Grammar

Parallel Structure

Parallel structure means using the same form for words that have the same level of importance in a sentence or for a list of items that are joined by a coordinating conjunction, such as “and” or “or.”

The scientist collected, dried, and weighed the samples.

When preparing bulleted or numbered lists use the same word type (i.e., all nouns, all verbs) and maintain parallel structure. If the listed items complete the introduction grammatically, place a period at the end of every line. Capitalize the first word in a bulleted or numbered list.

In preparation for the FE Exam, the students will review the following:

Circuits

Economics

Statics

Subjects and Verbs

It is important for text to flow smoothly. Subject and verb quality and agreement are essential and allow the reader to move through the text. To ensure the reader understands the intended meaning, abide by the following subject and verb rules and use the correct verb tense:

1. Subjects and verbs must agree in person and number---singular with singular, plural with plural.
2. A verb must agree with its subject, not with the words that come between the two.

The Club President, along with the officers, is going to the conference.

3. Subjects joined by “and” usually take a plural verb.

Platinum, gold, and lead are available in the laboratory.

4. When subjects are joined by “or” or “nor”, the verb agrees with the subject closest to it.

Either the samples or the machine is contaminated.

5. When using subordinate clauses with a pronoun as subject, the verb agrees with the antecedent to which the pronoun refers.

Robert earned excellent grades, because he worked very hard.

6. A verb agrees with the subject, even though in many cases the subject will follow the verb.

Educating the committee is difficult.

7. When using a linking verb (is, are, was, were, forms of be) the subject is the noun that precedes the verb, not the nouns that follow the verb.

The dogs are running down the street.

8. Select quality verbs that demonstrate an action. A list of action verbs is provided in Appendix G.

take any → accept

talk about → discuss

went up → rose, increased

leave out → exclude

go with → select

written up → composed

Active and Passive Voice

Take responsibility by writing in active voice; use passive voice only when it is appropriate for emphasis or when you lack information. Active voice distinctly identifies the subject and the action taken by the subject. The passive voice indicates that the subject receives, rather than performs, the action.

The sound's reverberation struck the walls.

Passive voice changes the position of the previous subject into an indirect object and focuses the sentence on what receives the action, the walls:

The walls were struck by the sound's reverberation.

When the active voice is appropriate, use it to create concise, energetic text. Only use the passive voice when it is appropriate to say that an action is done to the subject.

The final project was finished by the team. (passive)

The team finished the final project. (active)

For additional examples and explanation, visit the Purdue University Online Writing Lab (OWL) at: http://owl.english.purdue.edu/handouts/grammar/g_actpass.html.

Numbers as Words

1. Generally spell out isolated numbers from one to ten.

The discussion lasted for ten minutes.

2. Unless emphasizing them, spell out indefinite numbers that may be expressed in one or two words.

Approximately thirty appliances were damaged.

3. Spell out a number that introduces a sentence. If the number is long, recast the sentence to avoid awkwardness.

Twenty people attended the lecture.

4. Spell out common fractions that are used alone. However, use figures in writing a mixed number.

He refused to accept his one-fourth share. The hike was 10 ½ miles long.

5. When two numbers come together, express one in figures and the other in words. As a rule, spell the first number unless the second number is a significantly shorter word; i.e.,
Sixty \$5 bills or 500 four-page booklets.

6. When rounding numbers, spell out million or billion to make reading easier.

This tax legislation will increase revenue by \$7 million.

Numbers as Digits

7. Generally use numerals to express all exact numbers above ten.

The corporate file has been missing for 31 days.

8. Use the written form of a number for values 10 and below except to express market quotations, dimensions, temperature, decimals, street numbers, pages and divisions of a book, time, weights and measures, and identification numbers.

The experiment had three independent variables staged at 5, 10, and 15 degrees Kelvin.

9. If several numbers in a sentence perform similar functions, express them uniformly. If one is written as a figure, write all as figures.

The inventory shows 21 ranges, 9 refrigerators, 37 washers, and 10 dryers.

The 32 tables sold in five days. (The numbers do not perform similar functions.)

Citation

Documentation of important reference material is essential - do not plagiarize. Any statement that is unoriginal or is not a direct result of the project design must be referenced. Direct statements must include quotes and references. To ensure accountability, limit the use of open-source information, such as general encyclopedias or Wikipedia, to identify suitable academic citations for further investigation.

When compiling references, check with the publisher, professor, or company to determine the form to follow. If not specified, use any appropriate form as long as it is consistent. Two commonly used citation styles include the Modern Language Association (MLA) Style Guide or The Chicago Manual of Style. The following sites are examples of available web resources:

University of California Berkeley Library:

www.lib.berkeley.edu/TeachingLib/Guides/Internet/Style.html

The Chicago Manual of Style:

www.chicagomanualofstyle.org/tools_citationguide.html

Modern Language Association (MLA) recommendations on documenting website sources: www.mla.org/publications/style/style_faq/style_faq4

Use the author-date form for courses, unless an alternative form is approved. Provide the full bibliographic information in the Reference section and alphabetize by the author's last name. Always give a page or chapter number for books and page numbers for references to journal articles. Cite each reference parenthetically in the text by the author's last name and publication date. If the in-text citation is from a book, include the page(s) being cited, for example (Smith 2009, 8-11) . Separate multiple references by a semicolon (Smith (2001; Jones 2009). For two or three authors site each

(Smith, Jones, and Henry 2009, 23-25). When more than three authors, site the first followed by et al. (Smith et al. 2009, 2-5). Further examples are provided at the Murdoch University website noted above.

For unknown or unnamed authors, alphabetize by the organization or agency name. Examples include state and federal regulations (laws and administrative rules) and standards and protocols from professional organizations and governmental agencies such as ISO (International Organization for Standardization), US Environmental Protection Agency, Michigan Department of Environmental Quality. Include adequate information for the reader to locate each reference. If retrieved from a website, include the access date. Specific examples are provided below.

State of Michigan. Michigan Legislature. "Michigan Compiles Laws, Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act, Act 451 of 1994, as amended").

[www.legislature.mi.gov/\(S\(hdzekx55hemtgi45fdu15xmz\)\)/mileg.aspx?page=getobject&objectname=mcl-451-1994-ii-2-soil-conservation-erosion-and-sedimentation-control-91&highlight=>](http://www.legislature.mi.gov/(S(hdzekx55hemtgi45fdu15xmz))/mileg.aspx?page=getobject&objectname=mcl-451-1994-ii-2-soil-conservation-erosion-and-sedimentation-control-91&highlight=>) (accessed March 3, 2007).

Review

To make the revision process more efficient, review the document in passes. Focus first on content by evaluating the following questions, editing as needed to eliminate unnecessary or conflicting information.

1. Is the purpose and message clearly defined?
2. Are the key points and supporting details easily identified and complete?
3. Are there concepts or background information missing that the reader needs?
4. If information is deleted, will the reader's understanding be jeopardized?
5. Is the content accurate and complete with no exaggerations?
6. Does quality data support the conclusions?
7. Are the conclusions and recommendations clear and logical?
8. Are there contradicting statements?

Using the Technical Writing Checklist (Appendix A) as guidance, evaluate the figures and tables and make needed refinements. Then review for consistency, appropriate language, and text flow. Improve the style by reviewing each paragraph for coherency and considering the selected words, the structure of each sentence, and the information presented. Evaluate how each sentence combines with those preceding and following it. Refine the text to improve the clarity and interest until satisfied.

After an extended time, proofread for grammar, punctuation, and spelling, including correctly spelled but incorrectly used words, such as bases/basis, capitol/capital.

ASABE Standards

Introduction

Approved and cooperated with American National Standards and US Department of Agriculture National Resource Conservation Service

According to ASABE S612 JUL2009 a Type 2 Audit is defined as “A more detailed evaluation and report of a farm enterprise energy use that considers all major activities and components”.

Documentation

According to ASABE S612 JUL2009, these items/procedures are needed in every report

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

Assessment and Recommendation

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.

List of Possible Activities

The list of major activities and components is used by auditors to determine what they need to evaluate and document. This is a complete list; however some activities do not apply to certain operations. The ASABE S612 JUL2009 will be located in the appendix of this guide.

Activity	Component
Lighting	Lamps, Timers, Sensors
Ventilation	Fans, Control Systems, Variable drives, Humidity Controls
Refrigeration	Compressors, Evaporators/Chillers, Motor, Insulation
Milk Harvesting	Pumps, Motors, Controllers
Controllers	Master System Automation
Other motors/pumps	Compressors, and others
Water heating	Heater type, Energy Source, Insulation, Recovery, Waterers
Air heating/ Bldg Environment	Heater type, Energy Source, Insulation, Recovery, Variable Drive
Drying	Energy Source, Airflow (motors/fans), Handling equipment
Waste Handling	Collection and dispersal equipment/methods
Air Cooling	Energy Source, Airflow (motors/fans), Control Systems, Evaporative
Cultural Practices	Planting, Tilling, Harvesting, Engine Driven Equipment
Crop/Feed Storage	
Water Management	Wells, Reservoir, Recycling
Material Handling	Equipment, Motors, Pumps
Irrigation	Motors/Engines, Pumps, Power source

Definitions

- **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.
- **Energy resource:** Source from which energy is obtained, including gasoline, diesel fuel, biofuel, propane, natural gas, electricity, solar, wind, wood, biomass, geothermal, etc.
- **Farm enterprise:** Production category of a farm. For example, a farm may include a field crop enterprise and a livestock enterprise. (See Table 1)
- **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)
- **Component:** Individual parts of a major activity. For example: lighting systems include lamps, ballasts, timers, sensors, etc. (See Table 1)
- **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.
- **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.
- **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.)

Formatting

Subject Order

Each report should be written in the same general order. Professionalism and simpler peer reviewing needs consistent formatting. The following is the list of the order each report should take. The order does not limit or restrict the different subject matter.

1. Cover Page or Title Page
2. Table of Contents
3. List of Tables
4. List of Figures
5. Operation Overview
 - a. Operator Contact Information
 - b. Background
 - c. Management Style
 - d. Site Layout
6. Energy Conservation Measures Table
 - a. Other Summary Analysis Tables
7. Annual Energy Analysis (Electric and Gas)
8. Major Activities
 - a. Primary Equipment
 - i. Manufacturer, Model, Age, Usage, Maintenance, Condition, etc.
 - b. Type of Energy Used
 - c. Energy Consumption
 - d. Other Components of the Activity
 - e. Recommendations (Equipment and/or Management)
 - f. Savings and/or Production Increases
 - g. Payback (simple and/or complex)
9. Recommendation Summary
10. Potential Funding and Grants (if not already mentioned in major activity section)
11. Appendices
12. Acknowledgement
13. Signature

Cover Page

The cover page should include at least the following: name of the enterprise, type of audit, location, date, and the auditor or company. The cover page allows for more flexibility and creativity with regards to the font or the alignment. Large san-serif font with center alignment is recommended. There is also the option to use a picture. The margins for the document should be set based on the needs for the report. Different charts or graphs may need wider margins.

Table Formatting

First the title should be on the top left edge of the table. Numbering is important and it is easy to make a mistake. The font should be 10-11pt. san-serif. Bold font is optional, and italic font is malapropos. An example would look like this “Table 15: Energy usage over time”.

The pre-made table color formatting is acceptable. The main focus is that each cell is easily distinguishable. For example the first table is acceptable and the second is not.

Table 15: Energy usage over time

Month	Electricity Usage (kWh)
January	100
February	150

The font is contrasting with the background color and the main rows alternate in background color

Month	Electricity Usage
January	100
February	150

If you cannot see the font is black with is very difficult to see with the dark background. Contrast is very important in tables. Another area of concern is the large width of column two. Extra space is being unnecessarily used up by column two. Finally, there is not title for the slide.

Tables can be aligned left or center. The alignment of the characters in the table is at the discretion of the auditor. Microsoft Excel defaults the alignment for numbers to the right and text to the left. This is particularly useful for energy audit reports when numbers are accompanied by units. Now the number is directly adjacent to the units it is associated with.

Description	Value	Units
Vacuum Pump	7.5	hp

Headings

Headings should be used hierarchically. The major heading should be 16pt. san-serif font. The subheading should be 14pt. and the next subheading 12pt. font. Bold font is commonly used, but not mandatory. Headings should appear as followed:

Heading 1

Heading 2

Heading 3

The higher priority or more major heading should be larger and the next heading should be two font points smaller. As the headings get small the subject matter becomes more specific. Here is an example to get the idea:

Part One: Classical Physics

Chapter One: Kinetics

Section Three: Torque

Alignment is left and smaller headings can be tabbed according to the auditor's preference. Spacing for heading-heading or a heading-paragraph after a line is 6 to 10 pt. Use the spacing for paragraph-heading-paragraph as demonstrated in this guide. Line spacing is single only.

Body Text

The formatting for a paragraph and multiple paragraphs in succession should be the same throughout the report. Line spacing is 1 to 1.15 and 6pt. spacing after is the standard all reports require. A space is needed between paragraphs of the same style as seen on page 3 of this technical writing guide. The alignment should be justified.

Header/Footer

The header or footer must contain the page number. The auditor decides the format of the page number. Other items in the header or footer could include: company name, company logo, date, auditor name, etc. This is an area where the report can become more personalized and be characteristic of the specific auditor.

Appendix

The appendix should include all the raw data collected or calculated. Formulas, symbol identification, and sample calculation should be placed in the appendix. Any type of program created or used to evaluate the energy use or energy savings should be placed in the appendix. Generally, any excess information not needed immediately in the report itself .

Resources

The Chicago Manual of Style Guide:

www.chicagomanualofstyle.org/tools_citationguide.html

The Owl at Purdue provides online handouts, research, grammar, MLA, and APA

<http://owl.english.purdue.edu>

References

Biosystems Engineering Technical Writing Guide

<http://www.egr.msu.edu/age/documents/BE%20Technical%20Writing%20Guide%20Sept%2009.pdf>