Choose words with precision. Choose words carefully, and use the same word to refer to the same item. Is a tumor a "growth of cells" or simply "cells"? When describing fiber-optic technology, don't suddenly switch and call it "high-speed cable."

Use comparisons and examples. By comparing new information to ideas your audience already understands, you help build a bridge between people's current knowledge and the new ideas. For example, for a group of nonexperts, you could explain how earthquakes start in this manner:

> Imagine an enormous block of gelatin with a vertical knife slit through the middle of its lower half. Giant hands are slowly pushing the right side forward and the left side back along the slit, creating a strain that eventually splits the block. (Earthquake hazard analysis, 1984, p. 8.)

Use an appropriate organizational sequence. For longer descriptions, choose the organizational pattern that is most consistent with your purpose. If you want to describe how something looks or what parts it has, use a *spatial* sequence: Describe the items as your audience will see them. If you want to describe how something works, use a *functional* sequence: Describe the workings (functions) of the device. And if you want to describe how something is assembled, use a *chronological* sequence (see "Brief Instructions" and "Procedures" in Chapter 11).

Checklist for Definitions and Descriptions

- Is the length of the definition or description suited to its audience and purpose?
- Is the expanded definition adequately developed for its audience?
- Are visuals used adequately and appropriately?
- Does the definition appear in the appropriate location?
- Are comparisons and examples used to enhance understanding?
- Are any details missing, needless, or confusing for this audience?
- Does the description follow the clearest possible sequence?
- Will the level of technicality connect with the audience?
- Is the language clear and concise?
- Is the terminology precise and consistent?

contents, appendixes, and an index. Like short reports (see Chapter 10), long reports present ideas and facts to interested parties, decision makers, and other audiences. Technical professionals rely on reports as a basis for making informed decisions on a range of matters, from the possible side effects of a new pain medication to the environmental risks posed by a certain gasoline additive.

Long reports are called for in situations where an audience needs detailed information, statistics, and background information—the whole story. For example, your team of engineers needs to make far-reaching decisions about the best site for a toxic waste containment field. You have several months to research and make a decision, so you hire a consulting firm to report on all the relevant information. Their resulting product, a long report describing the geologic conditions of potential sites, might contain an appendix with detailed comparisons of topsoil, groundwater, and other conditions.

Audience and Purpose Analysis

Do your best to determine who will read the report. For instance, even if the report is addressed to team members, it may be sent on to other managers, the legal department, or sales and marketing. If you can learn about the actual audience members in advance, you can anticipate their various needs as you create the report. Before you start the report, be clear about its true purpose. For example, you may be under the impression that the report is intended simply to inform an audience. But after some initial research, you learn that your manager really wants you to recommend an action, not just state the facts. Recommending is different from informing, so it's important to understand the reason you are writing the report in the first place. For instance, the writers of the biodiesel report excerpted in Figure 12.5 made it clear that the audience was Georgia legislators and others making decisions whether or not to produce or use biodiesel. The document also has a clear purpose, stating clearly in the introduction, "The purpose of this report is . . ."

Types of Long Reports

Causal. Causal reports are used in situations where you need to explain what caused something to happen. For example, medical researchers may need to explain why so many apparently healthy people have sudden heart attacks. Or you might need to anticipate the possible effects of a particular decision, say, the effects of a corporate merger on employee morale.

Comparative. Comparative reports are used when you need to rate similar items on the basis of specific criteria. For example, you may need to answer questions such as "Which type of security procedure—firewall or encryption—should we install in our company's computer system?"

contents, appendixes, and an index. Like short reports (see Chapter 10), long reports present ideas and facts to interested parties, decision makers, and other audiences. Technical professionals rely on reports as a basis for making informed decisions on a range of matters, from the possible side effects of a new pain medication to the environmental risks posed by a certain gasoline additive.

Long reports are called for in situations where an audience needs detailed information, statistics, and background information—the whole story. For example, your team of engineers needs to make far-reaching decisions about the best site for a toxic waste containment field. You have several months to research and make a decision, so you hire a consulting firm to report on all the relevant information. Their resulting product, a long report describing the geologic conditions of potential sites, might contain an appendix with detailed comparisons of topsoil, groundwater, and other conditions.

Audience and Purpose Analysis

Do your best to determine who will read the report. For instance, even if the report is addressed to team members, it may be sent on to other managers, the legal department, or sales and marketing. If you can learn about the actual audience members in advance, you can anticipate their various needs as you create the report. Before you start the report, be clear about its true purpose. For example, you may be under the impression that the report is intended simply to inform an audience. But after some initial research, you learn that your manager really wants you to recommend an action, not just state the facts. Recommending is different from informing, so it's important to understand the reason you are writing the report in the first place. For instance, the writers of the biodiesel report excerpted in Figure 12.5 made it clear that the audience was Georgia legislators and others making decisions whether or not to produce or use biodiesel. The document also has a clear purpose, stating clearly in the introduction, "The purpose of this report is . . ."

Types of Long Reports

Causal. Causal reports are used in situations where you need to explain what caused something to happen. For example, medical researchers may need to explain why so many apparently healthy people have sudden heart attacks. Or you might need to anticipate the possible effects of a particular decision, say, the effects of a corporate merger on employee morale.

Comparative. Comparative reports are used when you need to rate similar items on the basis of specific criteria. For example, you may need to answer questions such as "Which type of security procedure—firewall or encryption—should we install in our company's computer system?"

Introduction

The State of Georgia faces two issues that may provide a unique opportunity for rural economic growth. The first issue is that major urban areas of the State have air quality problems that will require actions to reduce sources of pollution. One major pollution source is from exhaust emissions from cars and trucks. The use of alternative fuel sources such as biodiesel can make a significant reduction in certain exhaust emissions, thus reducing pollution and improving air quality.

The second issue facing the State is depressed crop farm incomes due to low market prices for the many oilseeds produced. Prices for soybeans, cottonseed and crush quality peanuts have been at very low levels for the last four years. These low prices have reduced farm incomes. Additionally, disposal of animal fat by-products and spent vegetable oils may become increasingly difficult in the future.

The opportunity for economic growth resides in the processing of these oilseeds and other suitable feedstocks produced within the State into biodiesel. The new fuel can be used by vehicles traversing the State, thus reducing air pollution and providing another market for Georgia produced oilseeds while creating a value added market for animal fats and spent oils. The benefits of biodiesel go far beyond the clean burning nature of the product. Biodiesel is a renewable resource helping reduce the economy's dependency on limited resources and imports. Also, biodiesel will help create a market for farmers and certain feedstocks and help reduce the amount of waste oil, fat and grease being dumped into landfills and sewers.

The purpose of this report is to provide decision makers with information on the feasibility of producing biodiesel in Georgia.

need long history lessons about the topic. In the introduction, identify the topic's origin and significance, define or describe the problem or issue, and explain the report's purpose. Briefly identify your research methods (interviews, literature searches, and so on). List working definitions, but if you have more than two or three, place definitions in a glossary. Finally, briefly state your conclusion. Don't make readers wade through the entire report to find out what you are recommending or advising. The strength of such brevity can be seen in the introduction to the biodiesel report shown in Figure 12.5.

Body. The body describes and explains your findings. Present a clear and detailed picture of the evidence, interpretations, and reasoning on which you will base your conclusion. Divide topics into subtopics, and use informative headings as aids to navigation, as in the body section of the biodiesel report excerpted in Figure 12.6.

Potential Drawbacks to Biodiesel

Biodiesel can be corrosive to rubber materials and liner materials. Biodiesel cannot be stored in concrete lined tanks. In some cases, the fuel intake orifices may need to be reduced in size to create a higher cylinder pressure. And, given current petroleum prices, biodiesel is more costly to produce than biodiesel.

Georgia Diesel Demand

According to the Petroleum Marketing Monthly, published by the Energy Information Administration, 4.64 million gallons of diesel were sold per day in Georgia in 2000. This included all diesels, low and high sulfur, auto and farm, amounting to about 3.89% of the national annual demand.

Several institutions that are influenced or controlled by the state government are large users of diesel fuel. Demand from school districts in the metro Atlanta (21 counties) amounted to 9,702,798 gallons used in 2000. MARTA estimates using 6,644,070 gallons of diesel in 2000. Finally, the Georgia Department of Transportation used 1,521,957 gallons of diesel in 2000 statewide. These three institutions alone use close to 18 million gallons of diesel per year. Map 1 illustrates the amount of diesel used in the Metro Atlanta counties during 2000.

The Biodiesel Production Process

The technology of converting vegetable oils and animal fats into biodiesel is a well established process. The most commonly used and most economical process is called the *base catalyzed esterification of the fat with methanol*, typically referred to as "the methyl ester process". Essentially the process involves combining the fat/oil with methanol and sodium or potassium hydroxide. This process creates four main products - methyl ester (biodiesel), glycerine, feed quality fat and methanol that is recycled back through the system. The primary product, methyl ester, is better known as biodiesel. The glycerine and fats can be sold to generate added income from the process.

Figure 12.6 Body of the Biodiesel Report.

Source: From "A Study on the Feasibility of Biodiesel Production in Georgia" by Professor George A. Shumaker, et al. February 3, 2003. Reprinted by permission of George A. Shumaker.

The body of your report will vary greatly, depending on the audience, topic, purpose, and situation.

Conclusion. As seen in the portion of the biodiesel report excerpted in Figure 12.7, the conclusion is important because it answers the questions that originally sparked the analysis. In the conclusion, you summarize, interpret, and recommend. Although you have interpreted evidence at each stage of your analysis, your conclusion presents a broad interpretation and suggests a course of action where appropriate. Your conclusion should provide a clear and consistent perspective on the whole document. Don't introduce new ideas, facts, or statistics in the conclusion.

Conclusions

There exist a variety of potential feedstocks both in Georgia and nearby states that could be utilized to produce biodiesel. These feedstocks vary significantly in price depending on supply and demand condition as well as market structural conditions. Feedstock costs represent between 50 and 75 percent of the cost of producing biodiesel, and thus a reliable source of low priced feedstocks is critical to success. A 15 million gallon biodiesel plant would require about 27% of the vegetable and animal fats currently available within the state of Georgia. This facility would produce 750 million gallons of 2% blend for approximately twice the state demand. A 20% blend will create 75 million gallons of B20 or roughly 20% of the Georgia diesel market.

The processing technology for producing biodiesel is well established and presents little technological risk. The production of biodiesel is a very efficient process, returning about 3.2 units of energy for each unit used in production. Biodiesel is thus an excellent renewable fuel source. Biodiesel can be very easily integrated into the existing petroleum distribution system from the handling, chemical, physical and performance perspectives.

Lacking government mandates or subsidies, a feedstock cost of about 10 cents per pound or less, given current diesel fuel prices, is needed for biodiesel to be cost competitive.

Figure 12.7 Conclusion Section of the Biodiesel Report.

Source: From "A Study on the Feasibility of Biodiesel Production in Georgia" by Professor George A. Shumaker, et al. February 3, 2003. Reprinted by permission of George A. Shumaker.

Front Matter and End Matter in Long Reports

A long document must be easily accessible and must accommodate users with various interests. Preceding the report is *front matter:* the title page, letter of transmittal, table of contents, and abstract or summary of the report's content. Following the report (as needed) is *end matter:* The glossary, appendixes, and list of references cited can either provide supporting data or help users follow

technical sections. Users can refer to any of these supplements or skip them altogether, according to their needs.

Title page. The title page gives the report title, the names of all authors, and their affiliations or the name of the organization that commissioned the report. The title announces the report's purpose and subject by using descriptive words such as *analysis, proposal, feasibility,* or *progress* (as in Figure 12.9).

Letter of transmittal. Many long reports include a letter of transmittal, addressed to a specific reader. This letter might

- Acknowledge individuals and organizations that helped with the report
- Refer to sections of special interest
- Discuss limitations of your study or any problems in gathering data
- Discuss possible follow-up investigations
- Offer personal (or off-the-record) observations
- Urge the recipient to immediate action

If a report is being sent to numerous people who are variously qualified and bear various relationships to you, individual letters of transmittal may vary.

Table of contents. Help readers find the information they're looking for by providing a table of contents. In designing your table, follow these guidelines:

- Number the front-matter (transmittal letter, abstract) pages with lowercase roman numerals. (The title page, though not listed, is counted as page i.) Number glossary, appendix, and endnote pages with arabic numerals, continuing the page sequence of your report proper, in which page 1 is the first page of the report text.
- Include no headings in the table of contents not listed as headings or subheadings in the report; the report may, however, contain subheadings not listed in the table of contents.
- Phrase headings in the table of contents exactly as in the report.
- List headings at various levels in varying type styles and indention.
- Use *leader lines* (. . . . . .) to connect headings to page numbers. Align rows of dots vertically, each above the other.

List of tables and figures. On a separate page following the table of contents or integrated with it, list the tables and figures appearing in the report.

Abstract or executive summary. Reports are often read by many people: researchers, developers, managers, vice presidents, customers. For readers who are interested only in the big picture, the entire report may not be relevant, so most

long reports are commonly preceded by an abstract (short) or an executive summary (longer). In this brief description, you explain the issue, describe how you researched it, and state your conclusion. Busy readers can then flip through the document to locate sections of importance to them.

In preparing your abstract, follow these suggestions:

- Make sure your abstract stands alone in terms of meaning.
- Write for a general audience. Readers of the abstract are likely to vary in expertise, perhaps more than those who read the report itself; therefore, translate all technical data.
- Add no new information. Simply summarize the report.
- Present your information in the following sequence:
  1. Identify the issue or need that led to the report.
  2. Offer the major findings from the body of the report.
  3. Include a condensed conclusion and recommendations, if any.

Appendixes. Add one or more appendixes to your report if you have large blocks of material or other documents that are relevant but will bog readers down if placed in the middle of the document itself. For example, if your report on the cost of electricity at your company refers to another report issued by the local utility company, you may wish to include this second report as an appendix.

Other items that belong in an appendix might include complex formulas, interview questions and responses, maps, photographs, sample questionnaires and tabulated responses, texts of laws and regulations, and the like. Do not stuff appendixes with needless information or use them unethically for burying bad or embarrassing news that belongs in the report proper. Title each appendix clearly: "Appendix A: Projected Costs." Mention the appendix early in the introduction, and refer readers to it at appropriate points in the report: "(see Appendix A)."

See, for example, Appendixes A and B in this textbook.

Glossary. Use a glossary if your report contains more than two or three technical terms that may not be understood by all audience members. Use standard definitions in your glossary: Refer to company style guides or technical dictionaries. If fewer than five terms need defining, place them in the report introduction as working definitions, or use footnote definitions. If you use a separate glossary, announce its location: "(see the glossary at the end of this report)."

List of references. List each of your outside references in alphabetical order or in the same numerical order as they are cited in the report proper.

Not all reports have all of these supplements. For example, the biodiesel report (Figure 12.9) omits the letter of transmittal because this report was presented in person. And, in that report, the introduction (Figure 12.5) also functions as the abstract. No glossary is needed because the opening pages present an expanded definition of biodiesel, its uses and production. A long appendix con-

taining calculations and formulas has been omitted here, to save space. Finally, there is no formal list of references because the bulk of the research is based on public sources or hired consultants, each cited in the text (as on page 10, bottom, in Figure 12.9).

For examples of many of these supplements in a student-written report, see "Feasibility Analysis of a Career in Technical Marketing," on the accompanying Web site, at www.ablongman.com/gurak.

Usability Considerations

Clearly identify the problem or goal. To address the true purpose of the situation, you must carefully identify your goal. Begin by defining the main questions involved in the report and then outlining any subordinate questions. Your legislator, for example, might pose this question: "Will producing biodiesel benefit the state of Georgia?" Answering this question is the main goal of the report; however, this question leads to others, such as "What are the drawbacks of biodiesel use?" Create a goal statement, such as "The goal of this report is to examine and evaluate claims about the production of biodiesel in the state of Georgia." (See pages 276–281 for the complete Biodiesel report.)

Provide enough information but not too much. Any usable analysis must address the needs, interests, and technical expertise of your audience. A long history of the development of the pacemaker may be interesting to you but inappropriate for your report. As you plan the report, find out how much of the information you've gathered readers need in order to make a decision. Also, make sure your technical terms are not too complex for your audience. If you have a mixed audience, provide a glossary where readers can look up unfamiliar terms. If your report is posted to a Web site, you can use hyperlinks for glossary terms.

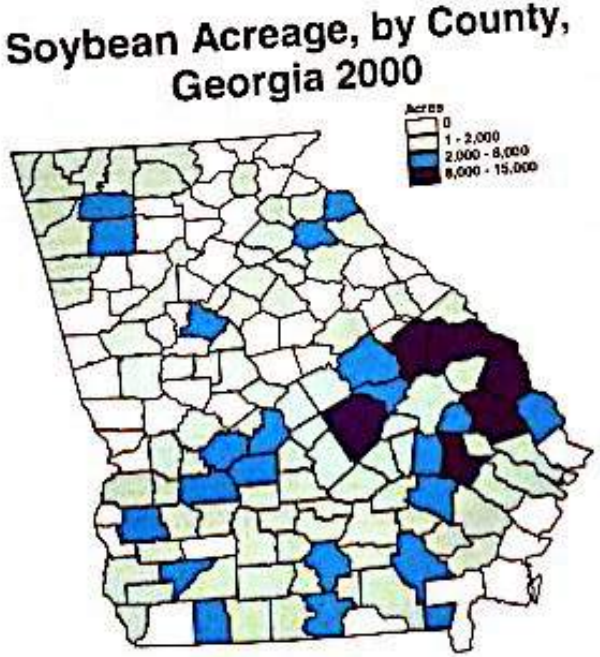
Provide accurate information. Make sure your information is as accurate as possible and, to the best of your ability, without bias. Use reputable information sources, particularly for statistical data. Be careful when taking information from the Web; Web sites often sound credible but can be based on biased or inaccurate information (see Chapters 4 and 5). Also, make sure you interpret information fairly and provide valid conclusions based on your best research. Assume, for example, that you were writing a report to recommend the best brand of chain saw for a logging company. In reviewing test reports, you learned that one brand, Bomarc, is easiest to operate but also has the fewest safety features. Both pieces of information should be included in the report, regardless of your personal preference for this brand.

Use appropriate visuals. As discussed in Chapter 9, visual information can make complex statistics and numeric data easy to understand. Graphs are especially useful for analyzing rising or falling trends, levels, and long-term forecasts. Tables and charts are helpful for comparing data. Photographs and diagrams are an

excellent way to show a component or special feature. Be sure your visual is placed near the accompanying text, and be careful not to overuse visuals. For example, the biodiesel report in Figure 12.9 makes good use of diagrams, such as the one featured in Figure 12.8.

Use informative headings. Headings and subheadings in your report announce what each section contains. The heading "Data Analysis" does not really say much, whereas the heading "Physiological Effects and Health Risks" offers a clear, informative preview of the content of a section.

Write clearly and concisely. Even readers who need every bit of information in your report don't want to be bogged down with prose that is cumbersome, long-winded, and hard to read. Keep your language crisp and clear. Use active voice whenever possible. Ask a colleague or editor to copyedit your report before it is printed.



Source: Center for Agribusiness and Economic Development

Figure 12.8 Visual from the Biodiesel Report.

Table of Contents

Introduction
Benefits of Biodiesel
Potential Drawbacks to Biodiesel
Georgia Diesel Demand
The Biodiesel Production Process
Figure 1 Diesel Utilization by Metro Counties, Georgia 2000
Figure 2 Methyl Ester Process
Feedstock Availability
Figure 3 County Distribution of Soybean Production in Georgia
Figure 4 Poultry Fat Production by County, Georgia 2000
Figure 5 County Distribution of Soybean Production in South Carolina in 1999
Historical Feedstock Costs
    Table 1 Historical Feedstock Cost Ranges, 1996-2000
    Feedstock Conclusions
    Table 2 Availability and Prices of Feedstock in Georgia
The Economics of Biodiesel Production
    Table 3 Estimated Capital Cost Comparison of Various Plant Sizes
    Table 4 Production Cost Sensitivity to Feedstock Cost by Plant Size, Dollars Per Gallon of Biodiesel
    Table 5 Estimated Biodiesel Capital Cost Details for a 15 Million Gallon Capacity Plant
Sensitivity to Feedstock Costs
Biodiesel Production Costs
    Table 6 Breakdown for Biodiesel Production for a 15 Million Gallon Per Year Facility with Feedstock Cost Averaging 17 Cents Per Pound
    Table 7 Total Production Cost Per Gallon of 100% Biodiesel at Various Average Feedstock Costs from a 15 Million Gallon Per Year Plant
Sensitivity to Changes in Budgeted Costs
    Graph 1 Profit/Loss versus Change in Budgeted Costs
Breakeven Feedstock Cost
    Graph 2 Profit/Loss versus Feedstock Costs
Sensitivity to Changes in Selling Price
    Graph 3 Profit/Loss versus Change in Sales Price
The Bottom Line – Can Biodiesel from the Proposed Facility Compete with Regular Diesel?
    Table 8 Added Cost to Retail Price of Diesel Fuel When Blended with 2 Percent Biodiesel
    Table 9 Added Cost to Retail Price of Diesel Fuel when Blended with 20 Percent Biodiesel
Biodiesel Products and Handling Considerations
Environmental Impacts of Biodiesel Use
    Table 10 Emission Changes with Biodiesel Fuels

Potential Drawbacks to Biodiesel

Biodiesel can be corrosive to rubber [illegible] and [illegible] materials. Biodiesel cannot be stored in concrete [illegible] tanks. In some cases, the fuel [illegible] may need to be [illegible] to create a higher [illegible] pressure. And, given current petroleum prices, biodiesel is more costly to produce than [illegible] diesel.

Georgia Diesel Demand

According to the Petroleum Marketing Monthly, published by the Energy Information Administration, 4.66 billion gallons of diesel were sold per [illegible] in Georgia in 2000. This included all diesels, low and high sulfur, [illegible] and farm, amounting to about [illegible]% of the national annual demand.

Several institutions that are influenced or controlled by the state government are large users of diesel fuel. Demand from school districts in the metro Atlanta [illegible] counties amounted to 9,[illegible] gallons used in 2000. MARTA estimates using [illegible] gallons of diesel in 2000. Finally, the Georgia Department of Transportation used 1,5[illegible] gallons of diesel in 2000 statewide. These three institutions alone use close to 18 million gallons of diesel per year. Map 1 illustrates the amount of diesel used in the Metro Atlanta counties during 2000.

The Biodiesel Production Process

The technology of converting vegetable oils and animal fats into biodiesel is a well established process. The most commonly used and most economical process is called the base catalyzed transesterification of the fat with methanol, typically referred to as "the methyl ester process". Essentially the process involves combining the fat or oil with methanol and sodium or potassium hydroxide. The process creates four main products: methyl ester (biodiesel), glycerine, feed quality fat and methanol that is recycled back through the system. The primary product, methyl ester, is better known as biodiesel. The glycerine and fats can be sold to generate added income from the process.

Biodiesel can be produced from any type of vegetable oil or animal fat. Some of the available feedstocks may require some pre-processing to remove materials that reduce the yield of biodiesel. Crude or unrefined vegetable oils contain free fatty acids and gums that must be removed before entering the reactor to ensure. The pre-processing can take the form of refining, degumming and/or filtering to remove the impurities. Degumming involves mixing a small amount of water (about 1-3%) with the feedstock which precipitates the gums which then can be separated by centrifuging the mixture. Refining involves adding sodium hydroxide to the feedstock to form a soap that can be separated by centrifuge from the oil. Various grease or waste restaurant fats must be filtered and refined to remove the free fatty acids and residual cooking fluids.

Some of these impurities have market value and can be sold as other industrial or food products. The fats can be used as feed additives for poultry and other livestock.

Feedstock Availability

Major feedstocks for biodiesel production currently available in Georgia include soybean oil, cottonseed oil, peanut oil, spent restaurant fats and rendered poultry fats. Other

Figure 3. County Distribution of Soybean Production in Georgia.

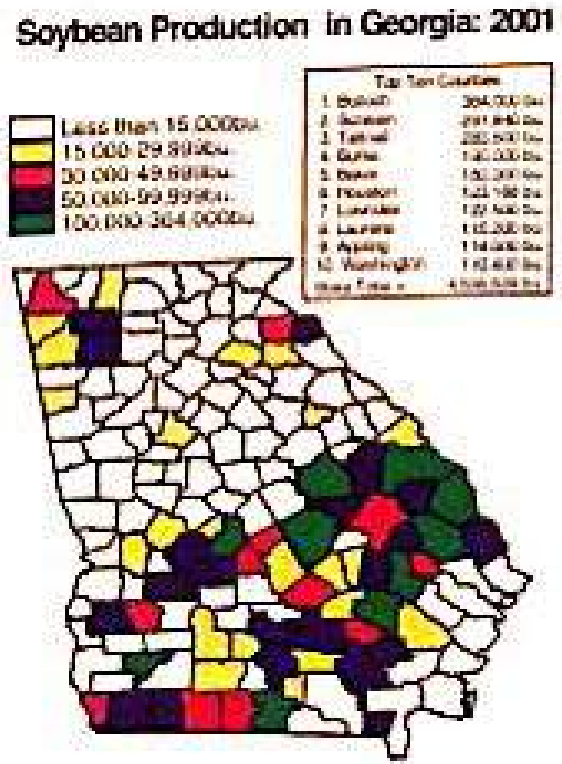
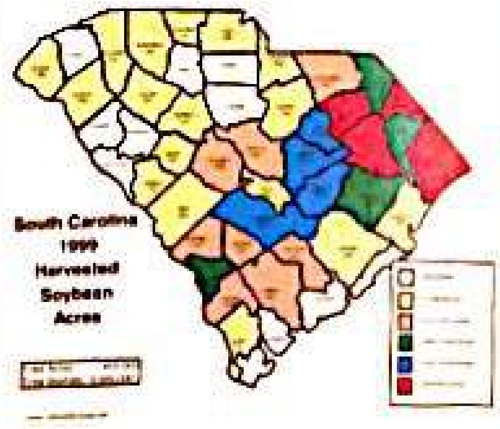


Figure 4. Poultry Fat Production by County, Georgia 2000



[illegible]

[illegible]

Historical Feedstock Costs

[illegible]

Feedstock	Price Range Per Pound	Pre-processing Cost Per Pound	Feedstock Cost Per Pound
[illegible]	[illegible]	[illegible]	[illegible]

Feedstock Conclusions

[illegible]

[illegible]

Table 2. Availability and Prices of Feedstock in Georgia

Feedstock	Quantity (1,000 gallons)	Price ($/lb)	Price Per Gallon	Total Gallons
Beef Tallow	[illegible]	[illegible]	[illegible]	[illegible]
Poultry Fat	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Available	[illegible]			[illegible]

[illegible]

The Economics of Biodiesel Production

[illegible]

[illegible]	1.5 mill [illegible]	22.5 mill [illegible]	[illegible]	225 mill [illegible]

Source: [illegible] Estimated Accuracy +/- 25%. Total includes capital cost for [illegible]

The capital cost ranges from [illegible] to $17 million depending on the capacity of the [illegible] ranged from [illegible] million pounds at the [illegible] to 225 million pounds at the highest level of production.

Table [illegible] Production Cost Sensitivity to Feedstock Cost by Plant Size, Dollars per Gallon of Biodiesel

Plant Size (million gallons/yr)	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Based on the data presented in Tables [illegible] and [illegible], it appears the more appropriate size facility [illegible] produces about 15 million gallons of biodiesel per year [illegible]. In Table [illegible] we see that most of the economies of scale are realized [illegible]. Unit costs of production do not appear to fall by doubling the size to [illegible] million gallon plant. Therefore, the remainder of this report will focus on a plant size of 15 million gallon capacity.

Capital Costs for the 15 Million Gallon Biodiesel Facility

The following table presents a breakdown of the capital cost components of a 15 million gallon per year capacity biodiesel production facility. The cost estimates represent a [illegible] facility placed upon a green site near transportation access.

[illegible]	[illegible]
Engineering [illegible]	[illegible]
[illegible]	[illegible]
Contingency [illegible]	[illegible]
Total Installed Cost	[illegible]
Source: [illegible]	

The physical plant would require approximately [illegible] to 10 acres for the building, tank farm and transportation areas. [illegible] level of development. The building needed to house the plant would be approximately [illegible] square feet and about [illegible] feet in height. [illegible] laboratory for quality control and offices. The processing area would [illegible] The tank farm area [illegible] about 20,000 square feet [illegible] This plant would operate continuously [illegible] would require an operating employment force of [illegible] sales, accounting and clerical.

Sensitivity to Feedstock Costs

The actual direct costs of production of biodiesel [illegible] total production costs (see Table [illegible]). Costs of feedstocks are the dominant factor in determining final production cost. In the 15 million gallon per year plant, total annual operating costs would be about $[illegible] million. [illegible] would represent about [illegible] percent of the total cost. Clearly, the ability to acquire low priced feedstocks is imperative to [illegible] cost of biodiesel production.

Biodiesel Production Costs

The cost of producing a gallon of [illegible] is highly dependent upon the average cost of the feedstocks used to produce it. The following table presents a detailed breakdown of

[illegible] production costs for a 15 million gallon facility with average feedstock costs of [illegible] cents per pound.

Table 6. Breakeven for Biodiesel Production for a 15 Million Gallon per Year Facility with Feedstock Cost Averaging 15 Cents per Pound

Item	Total[a]	Per Gallon
Sales	[illegible]	[illegible]
Feedstock & Direct	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Variable Cost	[illegible]	[illegible]
Fixed Cost	[illegible]	[illegible]
Total Cost	[illegible]	[illegible]
Profit/Loss	[illegible]	[illegible]

[a] Includes glycerin & [illegible] by-products

Table 6 indicates that the greatest portion of the cost is [illegible] biodiesel [illegible] feedstock and direct cost. [illegible] of the total cost when the feedstock is purchased for [illegible] per pound.

Table 7. Total Production Cost per Gallon of 100% Biodiesel at Various Average Feedstock Costs from a 15 Million Gallon per Year Plant

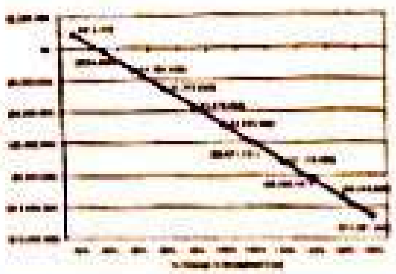
Average Feedstock Cost	Total Production Cost Per Gallon
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The results in Table 7 would be [illegible] between the final product cost and the feedstock cost. [illegible]

Sensitivity to Changes in Budgeted Costs

[illegible] The following chart demonstrates the impact of both higher and lower costs of production upon the net returns of the operation. [illegible]

Graph 1. Profit/Loss versus Change in Budgeted Costs



Graph 1 indicates the 15 million gallon facility needs to reduce costs by 22% to breakeven. [illegible]

Breakeven Feedstock Cost

The following graph clearly illustrates the relationship between the profitability or loss of a 15 million gallon facility as feedstock costs change. [illegible]

Table 8. Added Cost to Retail Price of Diesel Fuel When Blended With 2 Percent Biodiesel.

	Retail Diesel Prices Per Gallon						
	$0.60	$0.75	$0.90	$1.05	$1.20	[illegible]	[illegible]
Biodiesel Cost 100%	Added Cost in Cents per Gallon						
$1.25	0.013	0.010	0.007	0.006	0.003	0.002	[illegible]
$1.50	0.018	0.015	0.013	0.009	0.006	0.003	
$1.75	0.023	0.020	0.017	0.012	0.011	0.008	0.005
$2.00	0.029	0.025	0.022	0.019	0.015	0.013	0.010
$2.25	0.031	0.034	0.027	0.024	0.021	0.018	0.015

Gelling of biodiesel varies depending upon the chemical composition of the feedstock used in its production. The higher the saturated fat of the feedstock, such as in animal fats, the higher the temperature at which gelling occurs. The converse is also true. Canola oil, with low levels of saturated fats, derived biodiesel provides the lowest gelling temperature biodiesel. Pure biodiesel should be stored and transported at temperatures above 50 F and blending temperatures should be above 40 F.

Environmental Impacts of Biodiesel Use

Studies completed by the Environmental Protection Agency (NREL/TP 2001) note that a 20% blend is "basically a trade-off between cost, emissions, cold weather, material compatibility and solvency issues". Researchers believe the 20% blend to be the best blend for general use without encountering major issues. Higher blends often cause problems in winter and with nitrogen oxide emissions.

Table 10. Emission Changes with Biodiesel Fuels.

Emission	100% Biodiesel*	20% Biodiesel Blend*
Carbon Monoxide	-43.2%	-12.6%
Hydrocarbons	-56.3%	-11%
Particulates	-55.4%	-18%
Nitrogen Oxides	+5.8%	+1.2%
Air Toxics	-60% to -90%	-12% to -20%
Mutagenicity	-80% to -90%	-20%
Carbon Dioxide**	-78.3%	-15.7%

* Average of data from 14 EPA FTP Heavy-duty test cycle tests, variety of truck engines
** Life Cycle Emissions

It would appear that the use of biodiesel can be an effective means for reducing exhaust emissions. The relevant question becomes, how does the cost of reducing emissions using biodiesel compare to other means of attaining the same level of emissions reduction? The answer to that question is beyond the scope of this impact.

Impact Analysis

Impact analysis is a key component of any feasibility study. An impact analysis includes the effect of a new venture on the economy.

19

[illegible] demand for these items. These increased sales will ripple through the economy. An input-output model will capture and quantify these effects.

The input-output model IMPLAN (IMpact Analysis for PLANning, Minnesota IMPLAN Group) was utilized for this project. IMPLAN can predict the effects of a new venture on [illegible] employment and tax revenue. IMPLAN models can be constructed for a state, a [illegible] region or a county. Input-output models work by separating the economy into its various sectors, such as agriculture, construction, manufacturing, and so on. An IMPLAN model will show each sector and industry in the specific region's economy. The model can capture how a change in one industry (for example, biodiesel) will change output and employment in other industries.

A new sector was developed in IMPLAN to represent the biodiesel industry. The production function was created from the cost estimates provided by the research team. The production function was assumed to remain constant over the sizes of the plant. This may or may not hold true as returns to scale dictate.

The changes in the initial industry (biodiesel) are labeled direct effects and the changes in the other industries and household spending are called indirect effects. The direct and indirect effects are summed to give the total economic impact. Direct impacts are those at the plant. For instance, direct output is equal to total sales of the plant. Direct employment equals the number of people working at the plant. Indirect impacts are those that exist due to the plant's functioning. This would include people such as chemical suppliers, oil refiners, feedstock producers, and so forth.

Direct output of the 15 million gallon plant is \$17.4 million annually. This leads to indirect sales in the Georgia economy of \$16.9 million. In total, the economic impact of sales of the plant will be \$34.3 million. Fourteen jobs will be created at the plant. The operation of the plant will cause another 118 jobs to be developed in Georgia, thus total employment creation will be up 132 jobs. State and local non-education tax revenues will increase by \$2 million per year.

Table 11. Economic Impact on Sales, Employment and Revenue of a 15 Million Gallon Biodiesel Plant in Georgia

	Direct	Indirect	Total
Sales (Output)	\$17,373,000	\$16,899,718	\$34,272,718
Employment	14	118	132
Tax Revenue	N/A	N/A	\$2,116,876

The job creation is a one-time occurrence in that it indicates the total number of jobs created by the project. However, those jobs remain year-after-year. The money flows indicated by the economic impact and the tax revenues are recurring events year-after-year. This project has an economic lifetime of about 25 years, thus one can expect a total economic impact over the twenty five year period of about \$858 million dollars. The total tax flows over the twenty five year period would be about \$52.75 million.

20

This study focused upon the 15 million gallon plant size as it was felt it was the most appropriately scaled facility. One final summary table presents the IMPLAN results for each of the four plant sizes that were evaluated.

Table 12. Comparison of Total Impacts by Plant Size

	Total Output	Total Employment	Total Tax Revenue
500,000 Gallons	[illegible]	19	[illegible]
5 Million Gallons	[illegible]	55	[illegible]
15 Million Gallons	\$34,272,718	132	\$2,116,876
30 Million Gallons	[illegible]	[illegible]	[illegible]

Conclusions

There exist a variety of potential feedstocks both in Georgia and nearby states that could be utilized to produce biodiesel. These feedstocks vary significantly in price depending on supply and demand conditions as well as market structural conditions. Feedstock costs represent between 50 and 75 percent of the cost of producing biodiesel, and thus a reliable source of low priced feedstocks is critical to success. A 15 million gallon biodiesel plant would require about 27% of the vegetable and animal fats currently available within the State of Georgia. This facility would produce 750 million gallons of 2% blend for approximately twice the state demand. A 20% blend will create 75 million gallons of B20 or roughly 20% of the Georgia diesel market.

The processing technology for producing biodiesel is well established and presents little technological risk. The production of biodiesel is a very efficient process, returning about 3.2 units of energy for each unit used in production. Biodiesel is thus an excellent renewable fuel source. Biodiesel can be very easily integrated into the existing petroleum distribution system from the handling, chemical, physical and performance perspectives.

Lacking government mandates or subsidies, a feedstock cost of about 10 cents per pound or less, given current diesel fuel prices, is needed for biodiesel to be cost competitive.

21

Figure 6. Cotton Acreage by County, Georgia, 2000

22

Figure 7. Peanut Acreage by County, Georgia 2000

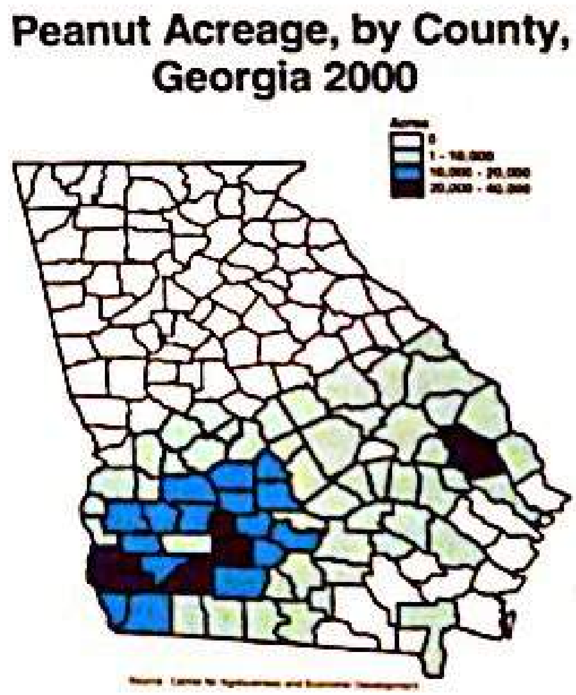


Figure 12.9 *(Continued)*

Use action verbs. Especially when recommending a plan of action, use action verbs such as *examine, evaluate, determine,* or *recommend.* Avoid nominalizations: Don't use *determination* when you mean *determine,* for example.

Checklist for Long Reports

- Does the report grow from a clear audience and purpose analysis?
- Does the report address a clearly identified problem or goal?
- Is the report's length and information adequate and appropriate for the subject?
- Is the information accurate and unbiased?
- Is there enough information for readers to make an informed decision?
- Are all necessary components (including front and end matter) provided?
- Are visuals used whenever possible to aid communication?
- Are headings informative and adequate?
- Are action verbs used generously?
- Is the level of technicality appropriate for the intended audience?
- Is the language clear and concise?

Proposals

Proposals encourage an audience to take some form of direct action: to authorize a project, purchase a service or product, or otherwise support a specific plan for solving a problem. Although proposals often contain the same basic elements as reports, they have one specific purpose: to propose an action or series of actions. This purpose differs from more generic reports, which can be used for other purposes, as noted earlier. Proposals can be called for in a variety of situations: a request to fund a training program for new employees, a suggestion to change the curriculum in your English or biology department, a bid to the U.S. Defense Department on a missile contract. Depending on the situation, proposals may be short or long and may be written in the form of a report, a letter, or a memo.

Audience and Purpose Analysis

In science, business, industry, government, and education, proposals are written for any number of audiences: managers, executives, directors, clients, board members, or community leaders. Inside or outside the organization, these people review various proposals and then decide whether the plan is worthwhile, whether the project will materialize, and whether the service or product is useful. At the most general level, the purpose is to persuade your audience. More specifically, proposals often answer questions about the nature of the problem or