31 March 2006

Sustainability Assessment Framework and Tool (SAFT) for Biobased Products and Technologies

Prepared for:

Environment Canada &
CBIN (Canadian Biomass Innovation Network)

Prepared by:

Five Winds International

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TABLE OF CONTENTS

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ACKNOWLEDGEMENTS

Five Winds International would like to acknowledge the following people and organizations for their invaluable contribution to the development of the *Sustainability Assessment Framework and Tool (SAFT) for Biobased Products and Technologies*:

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- *Marlo Raynolds, Executive Director*
  Pembina Institute for Appropriate Development

[1] To ensure the Sustainability Assessment Framework and Tool (SAFT) incorporates the perspectives and needs of primary users of the tool, Five Winds International conducted a needs assessment. The "Sponsors and Interdepartmental Committee Members" and "Needs Assessment Participants" shown above were interviewed to assess issues with the initial SAFT, and to better define their needs and expectations for the framework, methodology and tool. The results of these interviews were incorporated into this document and the associated Excel-based tool. Needs assessment details are available from Matthew Schacker, Environment Canada, Matthew.Schacker@ec.gc.ca, (819) 953-0439.

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This version of SAFT has been developed for Environment Canada and the Canadian Biomass Innovation Network (CBIN) based on concepts and content from previous work including:

- *Prototype Sustainability Assessment Framework and Toolkit (SAFT) for Application to Technology and Innovation Roadmapping*, developed by David Minns for Industry Canada, January 2003;
- *A Framework for Sustainability Assessment of Biobased Technology,* prepared for Environment Canada by the Pembina Institute, March 2002;
- *Project Performance Reporting System,* prepared for Green Municipal Funds by Five Winds International, February 2004;
- *Sustainability Business Casing Tool for Capital Projects,* prepared for Greater Vancouver Regional District (GVRD) by Five Winds International, December 2004; and
- Internationally accepted assessment standards and protocols such as ISO 14040 (LCA – Principles and Framework) and ISO 14064 (GHG Quantification and Reporting).

[2] To ensure the Sustainability Assessment Framework and Tool (SAFT) was practical and user friendly, Five Winds International conducted a series of three pilot test sessions with potential users. The results and findings from the pilot tests were incorporated into the final draft of this document and the associated Excel-based tool.

I. CONTEXT

WHY IS SUSTAINABILITY ASSESSMENT IMPORTANT FOR BIOBASED PRODUCTS AND TECHNOLOGIES?

Biobased products and technologies represent a significant opportunity to develop commercially viable products with improved sustainability performance. Canada is well positioned to capitalize on this emerging market (e.g., for renewable feedstocks) and has taken a number of steps to support the development of this industry such as the establishment of the Canadian Biomass Innovation Network and the development of Canada's Biotechnology Strategy.

Assessing the relative "sustainability" – the environmental, social and economic impacts and benefits – of biobased products and technologies at all stages of the development process is important to ensure benefits are well understood, potential risks are minimized and due diligence is exercised. People, including researchers, funders and policy makers, may assume biobased products and technologies will have better sustainability performance if they connect the word "bio" with "natural or organic", and do not properly assess the sustainability impacts across the life cycle, and over the long term (i.e., secondary and tertiary impacts). Demonstrating the sustainability of biobased products and technologies will also improve public and market acceptance of Canadian biobased products and technologies.

In addition, many federal funding programs have been designed to respond to a specific need or issue (e.g., climate change), and as a result, do not take the broader context of sustainability into account (i.e., the co-benefits or impacts of their decision-making).

To help Canada capitalize on the emerging market for biobased products and technologies, and to ensure government does this in accordance with the concept of sustainable development (Box 1), Environment Canada, together with Industry Canada, National Research Council and Natural Resources Canada, undertook this project to develop a credible, accessible and user-friendly ***Sustainability Assessment Framework and Tool (SAFT) for Biobased Products and Technologies.***

Bioproducts: Commercial or industrial products that rely on energy, chemicals or processes available from living organisms. If properly developed, the sources of bioproducts are renewable and can replenish themselves over and over again using energy from the sun. Bioproducts are a complement or an alternative to the industrial products manufactured using petrochemicals or fossil fuels.

Biotechnology: The application of biology and biological techniques to develop products and industrial processes.[1]

Pollution Probe and BIOCAP Canada Foundation, 2004. Primer on BioProducts. Available at http://www.cbin.gc.ca/KeyDocs-e.html

Box 1: Sustainable Development in Canada

Canada uses the Brundtland Commission's definition of sustainable development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

In Canada, the concept of sustainable development was integrated into federal legislation and into amendments to the Auditor General Act in 1995, which established the office of the Commissioner of the Environment and Sustainable Development. Federal Departments are required to prepare sustainable development strategies and table them in Parliament.

WHAT IS THE SUSTAINABILITY ASSESSMENT FRAMEWORK AND TOOL (SAFT)?

SAFT is a tool to help Canadian federal government program managers, funders and researchers systematically consider how to assess economic, social and environmental considerations in research and development (R&D) and investment decisions for biobased products and technologies. This version of SAFT supports a qualitative assessment at a fairly high level (e.g., "10,000 feet"). It does this by:

- Encouraging expert discussion and capturing expert opinion on technology or process and sustainability,
- Enabling projection of future sustainability impacts,
- Generating insights into technology and innovation needs to meet the performance levels required to support sustainable development, and
- Being user-friendly, rapid and low cost in application.

This tool is the second iteration, and has evolved from an initial *Prototype Sustainability Assessment Framework and Tool (SAFT) for Application to Technology and Innovation Roadmapping* developed by David Minns. This iteration of SAFT is one more stage in an evolution of the methodology. It was tested on the following three R&D projects funded through the Technology & Innovation Biotechnology program:

SAFT is a tool to get Canadian federal government program managers, funders and researchers thinking in a systematic way about how to integrate economic, social and environmental considerations in research and development (R&D) and investment decisions for biobased products and technologies.

- Extraction, Separation and Purification Processes for Value-Added Products – Isoflavones (Project Leader: Dr. Ashwani Kumar, NRC, Ottawa)
- Natural Fibers Initiative for Biochemical and Biomaterials (Project Leader: Adrien Pilon, NRC-BRI, Montreal)
- New and Improved Fatty Acid Biomass Feedstocks (Project Leader: Dr. Wilf Keller, NRC-PBI, Saskatoon)

It is important to understand that sustainability assessments of products in general, and biobased products and technologies in particular, are not currently widespread and SAFT is a starting point for conducting these types of assessments. As our understanding of how to assess the sustainability of biobased products and technologies grows, and more users become familiar with the SAFT methodology, improvements will be made to the approach. The goal of this version of SAFT is to provide (and be recognized) as a solid first step for government departments, international bodies (e.g. United Nations Environment Program (UNEP), the Organisation for Economic Cooperation and Development (OECD)), and non-governmental organizations.

Using SAFT can also help Federal Departments (including Industry Canada, Natural Resources Canada, National Research Council and Environment Canada) advance toward their Sustainable Development goals. SAFT complements Canadian regulatory commitments (e.g., CEAA, CFIA, CEPA, Strategic Environmental Assessment), Canadian government priorities in the area of biobased products and technologies (CBIN, Biotechnology Strategy) and other existing assessment methodologies (e.g., TEAM SMART, SDTC SDIRS). More importantly, SAFT fills an existing gap: the need to have a workable framework that enables sustainability to be considered when developing biobased products and technologies.

II. ABOUT THE SAFT TOOL

WHO SHOULD USE SAFT?

SAFT can be used by Government program managers, funders and researchers when making research and development (R&D) and investment decisions for biobased products and technologies. It is intended that future iterations of the tool also be suitable for other potential users, including private investors, industry, and university researchers conducting R&D work in this area.

SAFT **can be used by Government program managers, funders and researchers** when making research and development (R&D) and investment decisions for biobased products and technologies.

WHAT SHOULD SAFT BE USED FOR?

SAFT is a tool that **helps decision-makers and researchers incorporate sustainability criteria** (environmental, social and economic) into research & development, investment, and project planning & review decisions. It does not include technical feasibility or regulatory acceptability of a product or technology within its scope – these must be addressed outside of SAFT. There are several examples in government where researchers and funders select projects that meet only their specific program objectives or needs. This tool will help ensure technology projects incorporate a broader range of considerations that will help move Canada towards its goals of sustainable development.

SAFT is a tool that **helps decision-makers and researchers incorporate sustainability criteria** (environmental, social and economic) into research & development, investment, and project planning & review decisions. It does not include technical feasibility or regulatory acceptability of a product or technology within its scope – these must be addressed outside of SAFT.

As a framework it provides structure for the discussion and decision-making around the sustainability of the biobased product or technology under review. This is particularly useful in sustainability work because of the large number of assessment categories that can be considered, and the corresponding need for significant amounts of data and information.

SAFT should be **used as a screening tool as early as possible in the Technology and Innovation Commercialization process** (see Figure 1). It is at the early stages of this process that potentially negative impacts and benefits can be identified and, where appropriate, addressed (e.g., through redesign). SAFT can be used at other phases in the development process, however, the earlier it is used, the broader the scope of decisions or options available to the decision-maker. Using SAFT further along in the innovation process will still be beneficial; however, if potential issues are identified later in the process, fewer options may be available to address them by redesigning the technology or process.

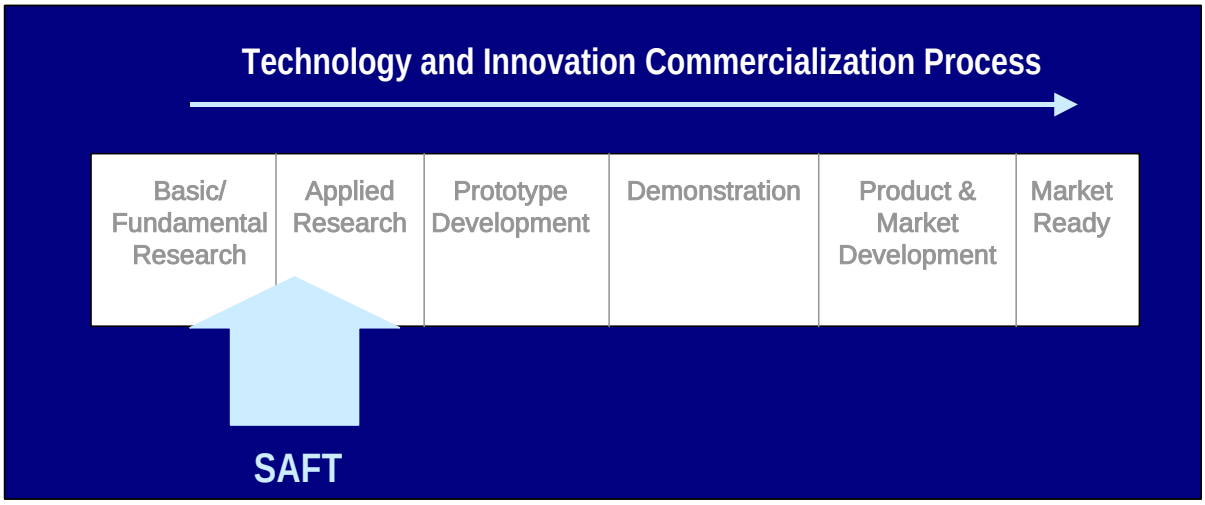


Figure 1: Ideal Stage to Apply SAFT in the Innovation Process

SAFT is a directional tool that will prompt decision-makers and researchers to **ask "the right questions", which will flag potential issues** with a biobased product or technology early in the innovation process.

SAFT is designed to **facilitate a comparative assessment** (i.e., which option is *more* sustainable?) as opposed to an absolute assessment (i.e., is this *a* sustainable option?). Users therefore need to exercise caution when communicating results of the assessment to other stakeholders as the tool will not provide a definitive evaluation of the sustainability of a biobased product or technology. SAFT will highlight environmental, economic and/or social assessment categories where one product or technology may be more, or less, sustainable than another. The comparison can be made with a conventional, non-biobased product or technology or a biobased one.

SAFT should not be used:

- ***…as the sole criteria when making an investment or funding decision***. SAFT may not enable "go or no-go" decisions and should not be used as the sole decision-making criteria. Rather SAFT is an input to decision-making, a way to broaden the considerations of government program managers, researchers and funders when making investment decisions. SAFT should be used in conjunction with other assessment tools already in use by program managers, researchers and investors when assessing biobased products and technologies.
- ***…as a comprehensive definition of what sustainable development means in the context of biobased products and technology.*** SAFT was designed as a screening level and directional tool that prompts researchers and funders to ask the right questions and identify potential "red flag" issues with a biobased product or technology.
- ***…as the only sustainability assessment conducted on a new biobased product or technology***. As with all new products and technologies, there is a level of uncertainty and risk associated with biobased products and technologies. Therefore there is a need for ongoing assessment from concept phase through to commercialization to consider new or changed information as it becomes available. Using SAFT as a screening tool to identify potential

issues is not sufficient to ensure all risks or benefits are managed effectively. Use of SAFT can be repeated as more data become available. Users are encouraged to delve into more detail on aspects such as critical information gaps or potentially negative impacts.

HOW LONG SHOULD THE ASSESSMENT TAKE?

SAFT should be used as a "screening" tool to identify potential sustainability impacts and benefits associated with a biobased product or technology. The length or level of review of the screening assessment should be relative to the scale of the decision or investment being made. The level of review from "start to finish" (including reading the methodology guidance, conducting the assessment, gathering additional data as necessary) might vary from one-half day to several days. Table 1 provides guidance on determining how long users should spend conducting the assessment using SAFT. Where red flags emerge, or where there is a lack of information, "deeper dives" or more detailed assessments are recommended.

Table 1: Level of Effort Required Relative to Scale of Decision

	Level 1	Level 2	Level 3
General factors potentially affecting the scope of assessment			
System to be assessed	Life cycle of one biobased product or technology	Partial life cycle of value chain	Whole life cycle of value chain
Size of potential market	Small market applicability	Medium sized market applicable	Wide scale market applicability
Size of investment	Small	Medium	High
Purpose	• Expand scope of assessment to include social, economic and environmental considerations • Identify potential "red flag" areas of unsustainability for further investigation	• Expand scope of assessment to include social, economic and environmental considerations • Identify key trade-offs and targeted areas of improvement	• Expand scope of assessment to include social, economic and environmental considerations • Identify key trade-offs and targeted areas of improvement, support go or no-go decisions
General Guidance for Appropriate Level of Assessment			
Team Members	• Program Manager or Research Director leads with support of research team members and sustainability specialist	• Program Manager or Research Director leads with support of research team members and sustainability specialist • Could include external stakeholders such as subject matter experts (i.e., economists, social scientists, etc.) and experts on the baseline for comparison as well as the system • Consider involving an	• Program Manager or Research Director leads with support of research team members and sustainability specialist • Could include external stakeholders such as subject matter experts (i.e., economists, social scientists, etc.) and experts on the baseline for comparison as well as the system • Could also include

Table 1: Level of Effort Required Relative to Scale of Decision

	Level 1	Level 2	Level 3
		independent facilitator	stakeholders from across the value chain (producers, processors), regulators, industry associations, etc. • Consider involving an independent facilitator
Report Format and Documentation	• Answers to the questions • Summary results (in table or graphic) • Short report that states goal and scope, results, conclusions and recommendations	• Answers to the questions • Summary results (in table or graphic) • More detailed report summarizing goal and scope, results, conclusions and recommendations	• Answers to the questions • Summary results (in table or graphic) • Very detailed report summarizing goal and scope, results, conclusions and recommendations
Expected resources start to finish	½ - 1 day	1- 3 days	3 days - 1 week Deeper dives where required
Requirement for Supporting Data and Information (qualitative, quantitative)	Low	Moderate	High
Level of Review	First Party (colleague)	Second Party (unrelated peer)	Third Party (external)

III. CONDUCTING THE ASSESSMENT

Figure 2 provides an overview of the step-by-step SAFT sustainability assessment process.

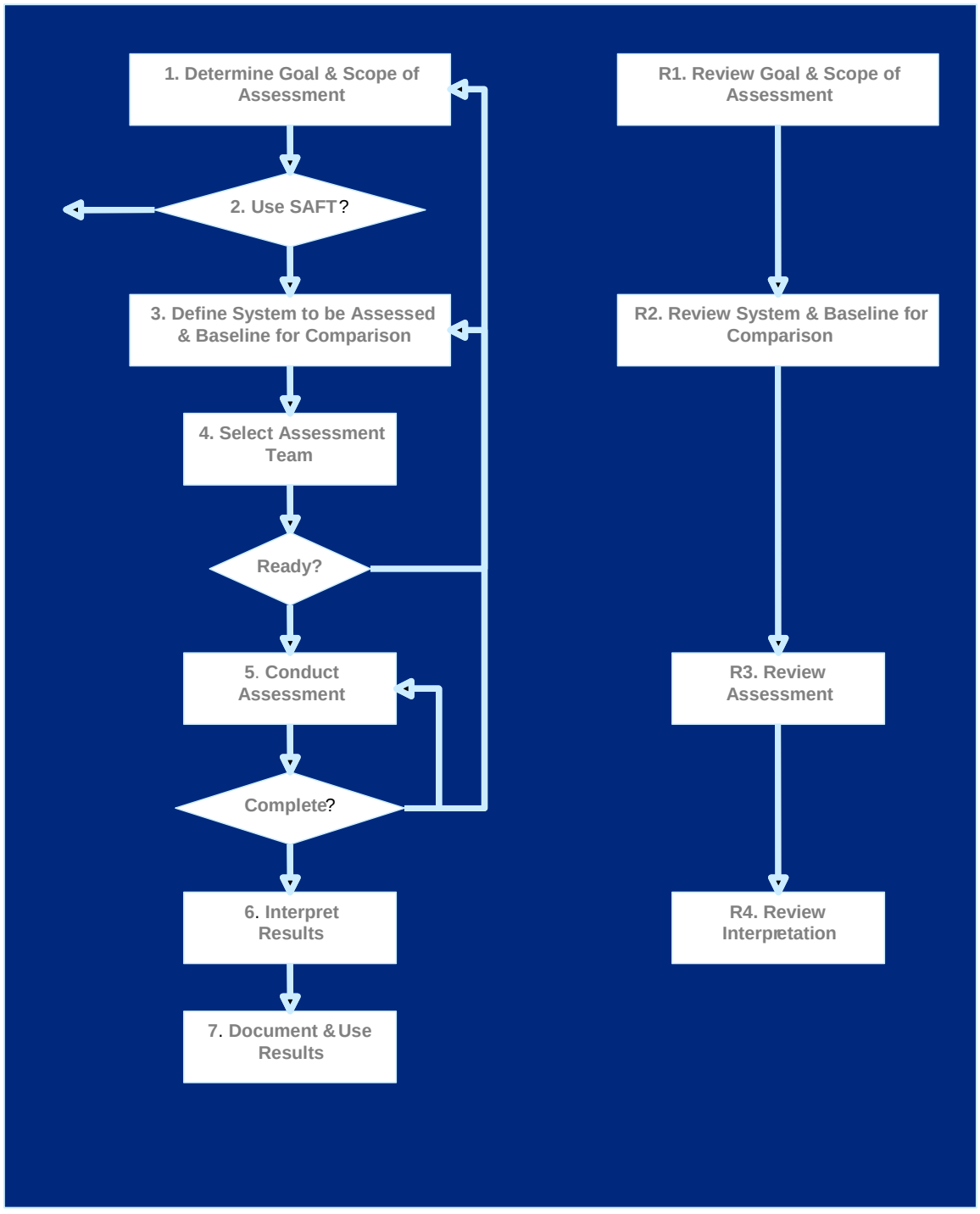


Figure 2: Overview of SAFT Assessment Process and Optional Review Process

Each of the seven steps of the assessment process is described in this section. Instructions and examples are provided to help users complete each step. The assessment is often an iterative process and some steps may need to be completed more than once. For example, after selecting your assessment team, the additional expertise available may help determine that the Goal and Scope needs to change, or that the System and/ or Baseline need to change.

It is time to begin the SAFT assessment process!

STEP 1: DETERMINE GOAL AND SCOPE OF ASSESSMENT

Step 1 is an extremely important step in the assessment process as it sets the stage for decisions required in subsequent steps. The validity of decisions made in subsequent steps needs to be evaluated in the context of the Goal and Scope of the assessment. Although the general goals of SAFT will not vary on a case-by-case basis, the specific goals of each SAFT assessment will vary.

The Goal(s) of a SAFT assessment should unambiguously state the intended use of the results, the reasons for carrying out the assessment and the intended audience; i.e. to whom the results of the assessment will be communicated. In most cases, the audience for a SAFT assessment will be Canadian federal government program managers, funders and researchers. However, it could also include other stakeholders (e.g. potential industrial partners).

Goal:

What is the assessment going to be used for?

What decisions (if any) will be supported?

Who will the results be communicated to?

Examples:

- To identify potential issues and opportunities to improve the sustainability performance of a specific biobased product or technology;
- To compare the sustainability performance of the selected biobased product or technology to the conventional alternative, to support discussions with potential industrial partners;
- To identify common risks, opportunities and funding priorities for specific government programs;
- To support due diligence to ensure funding is not applied to “unsustainable” biobased products or technologies;
- To engage stakeholders, including potential adopters, in assessing the sustainability of a specific biobased product or technology;
- To inform specific stakeholders on the sustainability performance of specific biobased products or technologies;
- To compare various options within a specific biobased value chain, identify potential sustainability impacts and benefits, and support design choices;
- To compare different biomass feedstocks and identify potential sustainability impacts and benefits;
- To compare different manufacturing/ transformation processes for biobased products and technologies;
- To compare different end of life options for specific biobased products and technologies.

Scope:

What is to be included in the assessment?

Be sure the scope of the assessment is consistent with the intended use(s) or goals of the assessment.

Examples:

- Limited to a specific geographic location;
- Full life cycle of the biobased product or technology;
- Feedstock production, collection, pre-processing and transport only;
- Processing/ Transformation processes only;
- Number of potential applications e.g., a single application, a single hectare of land, eight biodiesel refineries;
- Product use options only;
- Product end of life options only;
- Geographic scope (e.g., Canada, Region, Province, Global);
- Temporal scope (e.g., Year of commercialization, How far into the future will impacts be projected? Are impacts during a specific time interval key?).

Examples of Goal & Scope statements from the SAFT pilot tests are shown below.

- To compare the proposed production of isoflavones from red clover feedstock (scaled up from laboratory process to industrial production) to the current industrial-scale production of isoflavones from soya feedstock.

- To compare the proposed production of fibres from flax by-product using a combination of physical, chemical and biological processes to the current production of fibres using a conventional, mechanical process.

- To compare the proposed production of erucic acid from SHEAR (Super High Erucic Acid Rapeseed) feedstock to the current production of erucic acid from HEAR (High Erucic Acid Rapeseed) feedstock.

Depending on the Goal and Scope of the assessment, various levels of review may be appropriate. Refer to Table 1 above and the "Optional Review" description below for guidance about appropriate review levels. In general, larger scale investments or decisions require a higher level of review. It is important to decide what level of review is required as early as possible in the process, and ensure the review process occurs in parallel to the assessment process (see Figure 2). This will facilitate the review process contributing to the quality and credibility of the assessment. If the review process occurs too late in the process it may not be effective, or time and effort may be wasted if steps have to be revised in response to review recommendations.

Document the Goal and Scope and circulate it to relevant colleagues or stakeholders for comment, or for their records as appropriate.

STEP 2: DOES SAFT APPLY?

Given the Goal and Scope documented in Step 1, consider whether the use of SAFT will satisfy the goals and objectives of the analysis. SAFT may be an appropriate tool for some situations but not for others. As discussed above, SAFT should not be used as the only sustainability assessment conducted on a new biobased product or technology. Using SAFT to identify potential issues with a biobased product or technology is not sufficient to ensure all impacts or benefits are managed effectively. Also, use of SAFT can be repeated as more data becomes available, and users are encouraged to consider the use of other tools, methodologies, or concepts that could complement SAFT or may be more appropriate to their needs.

The tools and concepts listed in Box 2 could potentially complement SAFT. Each of these tools and concepts are briefly described in Appendix 1.

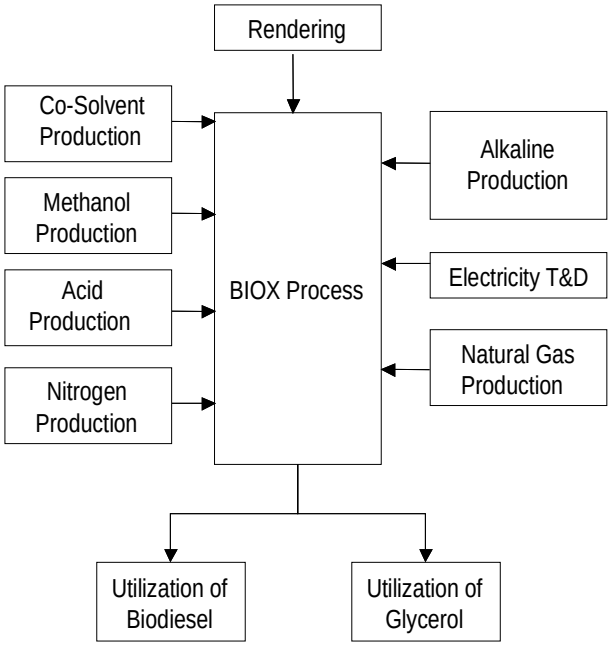
Box 2: Complementary Sustainability Tools & Concepts

- Design for Environment (DfE)
- Eco-efficiency
- Ecological Footprint
- Environmental Impact Assessment (EIA)
- Environmental Risk Assessment (ERA)
- Industrial Ecology (IE)
- Life Cycle Assessment (LCA)
- Life Cycle Costing (LCC)
- Life Cycle Management (LCM)
- Precautionary Principle
- Stakeholder Engagement
- Social Impact Assessment
- The Natural Step Framework

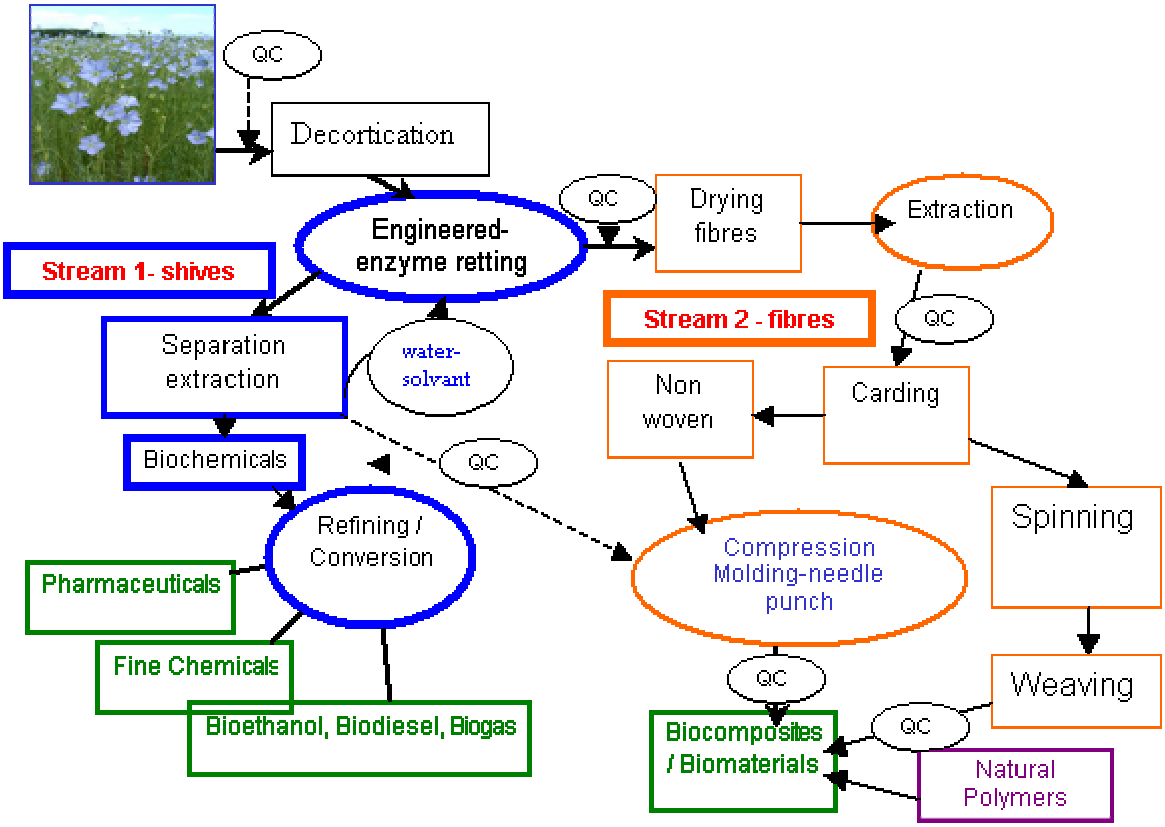
STEP 3: DEFINE SYSTEM TO BE ASSESSED AND BASELINE FOR COMPARISON

Step 3 establishes the "boundaries" for subsequent assessment steps. Given the Goal and Scope established in Step 1, what "System" needs to be assessed? In its broadest sense, the "System" could include all upstream and downstream processes related to the biobased product or technology being assessed. Information and time constraints often restrict the extent of what can be included in the system. In general, aim to be comprehensive and consider as many significant upstream and downstream processes as is reasonable. For example, when assessing the sustainability of an agricultural feedstock, it is important to include significant upstream impacts associated with any chemicals used to produce it such as fertilizers or pesticides, as well as the direct impact of farm based fossil fuel consumption, etc.

Construct a diagram such as the ones shown in Figure 3 and 4 to define the system being assessed. When drawing this diagram, include all significant processes (i.e., flows of materials or energy; emissions to the environment; other impacts) and any information available on the geographic location and receiving environment (e.g., agricultural area in Southern Manitoba, rural community, no specific environmental stressors identified).



Source: BIOX Corporation (used with permission)
Figure 3: Example of System to be Assessed



Source: Adrien Pilon, Pilot Test Participant (used with permission)
Biomass to Bio-products Process Flowchart
Figure 4: Example of System to be Assessed

As discussed above, SAFT is based on the concept of "comparative assessment". This means that SAFT can be used to help determine which biobased product or technology option is *more* sustainable; or if the biobased product or technology is more sustainable than its conventional equivalent. Hence, it is necessary to establish the "Baseline" that the "System" will be compared against. As for the System, the Baseline should be comprehensive and consider as many significant upstream and downstream processes as is reasonable.

If the Baseline is not obvious, consider several potential baselines and use criteria to select the most appropriate of these. In most cases, the Baseline will be either:

- A conventional product or technology system that could be replaced by the biobased product or technology system; or
- A variation on the biobased product or technology system that could replace it.

To develop potential baselines, consider the following:

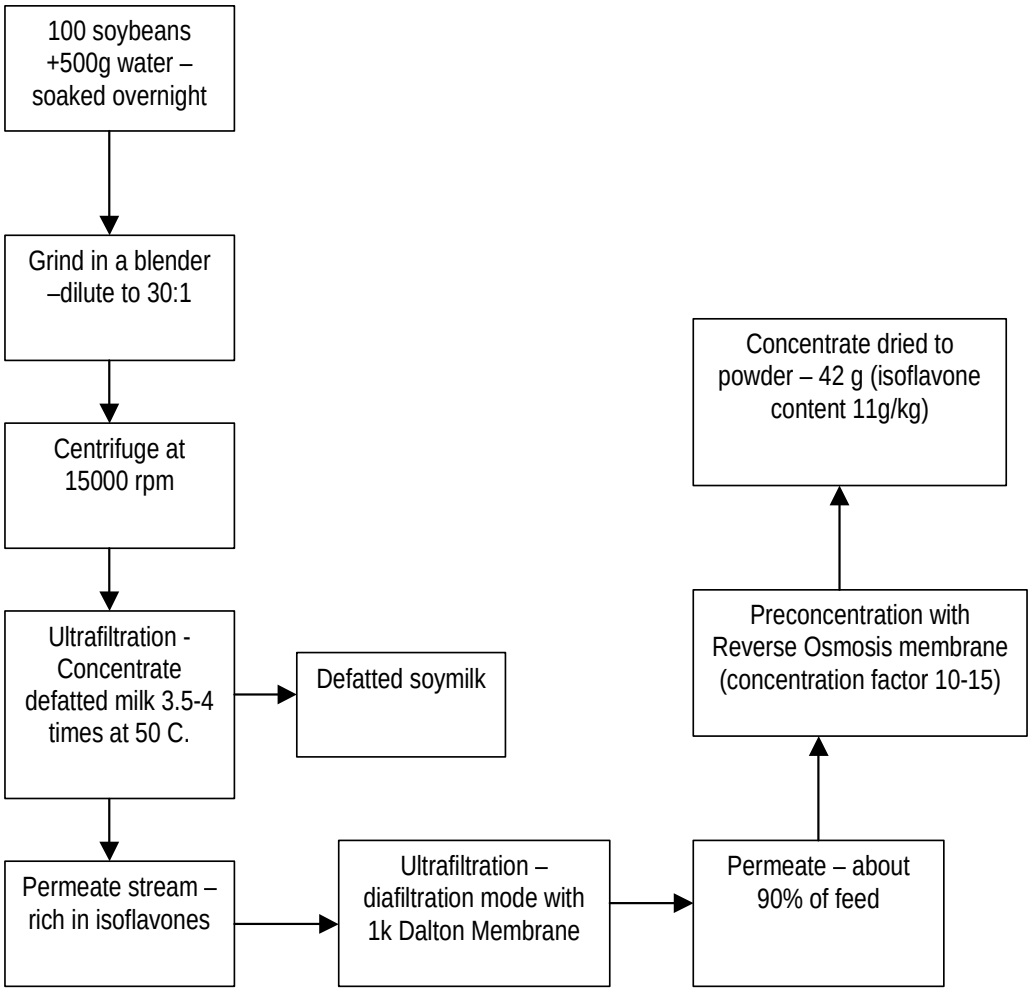
1. What product(s) or service(s) are provided by the System?
2. What are the alternative methods (existing or potential) for providing these product(s) or service(s)?
3. What data and information is available about these alternative methods?
4. What other information could affect the present or future technical feasibility and market acceptance for these alternative methods (e.g., legislation, technology, economic drivers, environmental drivers, social drivers)?

Develop several potential baselines using these considerations, unless the most appropriate baseline is clear. To select the most appropriate baseline, use the following criteria to identify strengths and weaknesses of each:

1. If the proposed biobased System were not developed and commercialized, which potential baseline is most likely to occur?
2. Which potential baseline provides the same product(s) or service(s) as the System?
3. Which potential baseline are the users of the SAFT assessment most likely to consider?
4. What data and information is available for each potential baseline?
5. Additional assessment-specific criteria may be used if required.

After identifying the strengths and weaknesses of each potential baseline, select the most appropriate baseline and record your rationale for this choice.

When the most appropriate baseline has been selected, draw a diagram such as the one shown in Figure 5 to define the baseline being assessed.



Source: Dr. Ashwani Kumar, Pilot Test Participant (used with permission)
Production of defatted soymilk and Extraction and refining of isoflavones from soymilk waste stream

Figure 5: Example of Baseline to be Assessed

Since SAFT is based on the concept of comparative assessment, it is very important to ensure that the system and baseline are comparable. For example, if the baseline conventional product or technology produces other products or by-products not produced by the biobased product or technology, it is important to take this into consideration. In more quantitative methodologies such as life cycle assessment, this is often accomplished using various allocation rules or algorithms. This would not be appropriate for SAFT. However, it is important to define the system and baseline to be as functionally equivalent as possible to ensure a valid assessment. Any significant differences in their functionality (i.e., differences in good(s) or service(s) provided) should be documented and referred to later when conducting and interpreting the assessment.

STEP 4: SELECT THE APPROPRIATE ASSESSMENT TEAM

Now that you have determined the goal and scope of the assessment, determined that SAFT is an appropriate tool, and defined the system and a baseline, you are ready to select the assessment team. It is recommended that users complete the assessment as a team involving at least a Program Manager or Research Director, one or more research/ program team members and a sustainability specialist. Using SAFT as a team will help to ensure the range and scope of assessment categories can be covered in a time efficient manner and that credibility and accountability are built into the process. If the project team does not already include a sustainability specialist, involving one will help project teams identify potential sustainability impacts and issues, and better incorporate economic, social and environmental considerations in research and development (R&D) and investment decisions.

Depending on the scope and level of the assessment determined in Step 1, a smaller or larger assessment team may be appropriate (see Table 2).

Table 2: Potential Assessment Team Members Relative to Level of Assessment

Level of Assessment	Level 1	Level 2	Level 3
Assessment Team Members	• Program Manager or Research Director leads with support of research team members including sustainability specialist	• Program Manager or Research Director leads with support of research team members including sustainability specialist • Could involve external stakeholders, experts in economics, environmental impacts or social impacts as appropriate, experts on the baseline for comparison as well as the system • Consider involving an independent facilitator	• Program Manager or Research Director leads with support of research team members including sustainability specialist • Could involve external stakeholders, experts in economics, environmental impacts or social impacts as appropriate, experts on the baseline for comparison as well as the system • Could also include stakeholders from across the value chain (producers, processors), regulators, industry associations, etc. • Consider involving an independent facilitator

As you expand the level of effort for your assessment (based on the scale of investment or decision being made), include external stakeholders and experts in economics, environmental or social impacts as appropriate. Stakeholders from across the value chain, regulators and industry associations can also contribute additional knowledge and their involvement can help you garner support for your proposed biobased product or technology. Generally, involving other stakeholders will help you tap into expertise required to complete the assessment, fill in knowledge gaps and increase the transparency and credibility of the approach.

In a level 2 or 3 assessment, involving an independent facilitator who is familiar with the SAFT methodology and knowledgeable about sustainability would be beneficial. As the number of participants increase (i.e., if external stakeholders are involved), a facilitator will help to ensure the

assessment process remains on track. The independent nature of a facilitator can also provide some objectivity to the assessment results.

Assessment Team:

Who should be included?

When putting your assessment team together, consider the following:

- Does the assessment team cover the scope of assessment (i.e. subject matter expertise, understanding of both the system and the baseline)?
- Does the assessment team cover the range of issues/ questions in SAFT?
- Does the assessment team include a Program Manager or Research Director, one or more research/ program team members and someone with expertise in sustainability issues?
- Would there be added value in involving stakeholders from across the value chain (producers, processors), regulators and/ or industry associations?

If your team does not fulfill the criteria above, try to include someone who can fulfill these requirements.

Once you have organized your assessment team, select a time and date to conduct the assessment. If located in the same city, it is recommended the assessment team meet in a workshop or round table arrangement to complete the assessment. If team members are in different locations, use of a videoconference set-up is recommended. Set aside ½ day to conduct the assessment as a group; if the group cannot answer some of the questions, additional follow up will be required to gather the necessary information to complete the assessment.

Alternatively, the team could decide to complete the assessment (Step 5) individually and meet to compare their assessment results with other team members. Personal working styles may dictate which approach is selected.

Ideally, Steps 1-3 will be carried out in advance of the workshop and circulated for comment. Team members should be invited to compile and circulate any related data and information on the biobased product, technology or value chain in advance (e.g., process flow diagrams, life cycle studies,[3] market assessment information, previously published journal articles) and bring it along with them when they come to the workshop.

STEP 5: CONDUCT ASSESSMENT

You are now ready to conduct the assessment using the SAFT Excel-based tool. It is helpful to have the tool open in front of you as you read through this section. To begin using the tool, make sure to "enable macros". If you were asked to enable macros and you did not enable macros when opening the tool; close the tool and reopen it, then select "Enable Macros" when asked. You may need to change your Excel security settings by going into the Tools menu and selecting Options; click on the Security tab and then the Macros Security button; change your

Where can I get a copy of the SAFT Excel-based tool?

Contact…

Matthew Schacker
Environment Canada
Matthew.Schacker@ec.gc.ca
(819) 953-0439

or…

Download from the CBIN website:
www.cbin-rcib.gc.ca

[3] Reference for environmental attributes of various bio threads: "Environmental Impacts of Plants Used for Chemical, Material and Energy Purposes (from ADEME, the French Agency for Environment and Energy Management)" is available from http://www.cbin.gc.ca/KeyDocs-e.html

setting to Medium; click OK; and enable macros when you open the tool.

The SAFT Excel-based tool includes a series of questions about the environmental, economic and social impacts and benefits of the biobased product or technology system and baseline. You should respond to each question even if your feel the question is not applicable to your situation. Each question represents one of approximately 20 assessment categories and will help you systematically consider the sustainability impacts and benefits associated with the biobased product or technology being assessed.

Use the SAFT Excel-based tool to respond to each question. This version of SAFT supports a qualitative assessment; future versions of SAFT may incorporate quantitative assessment. The following steps should be used with the tool:

Box 3: Example items to note in comments section of assessment worksheet

- Level of confidence in the selection;
- Level of documentation or data supporting the selection;
- Any assumptions used;
- Area of divergence in opinion in among team members;
- Area of positive impact (as impact categories are designed to score negative impacts, or the "unsustainability" of a product or technology).

- **Review the assessment categories, the corresponding question and scoring guidance**. Scoring guidance is easily accessible by clicking on the impact category name in the first column of the "Assessment" spreadsheet. The scoring guidance includes important information about what the question means and what the various scoring levels mean (e.g., not applicable, none, low, medium, high, very high).
- Consider **what life cycle stages apply** to the system and baseline. It is not always necessary to consider all life cycle stages. However, if you omit some, you should be prepared to explain or justify why they are not significant to the assessment (e.g. identical between system and baseline).
- **Score the System and Baseline** for the applicable life cycle stages.
- If necessary, **add comments to qualify your selection**. Documenting the thought process behind each selection may be useful when it comes time to communicate the results or to repeat the assessment at a later stage in development of the biobased product or technology. Box 3 provides some examples of information you may want to note in the comments field.

Making Changes to the SAFT Excel-based Tool

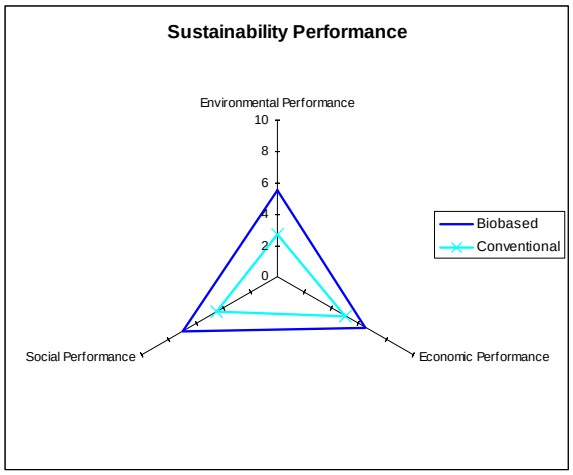
Depending on the details of your assessment (e.g. Goal & Scope, System, Baseline, etc.), there may be a need to make changes to the SAFT Excel-based tool. The most likely change would be to add environmental, economic or social impact categories. To improve consistency between assessments, making changes to the Excel-based tool is not recommended. Note that the Excel-based tool is password protected. Details on how to make changes, including the password, are included in the "Instructions" section of the tool.

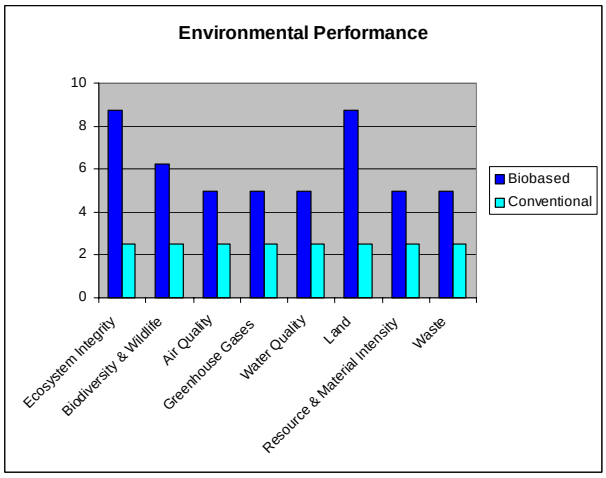
STEP 6: INTERPRET ASSESSMENT

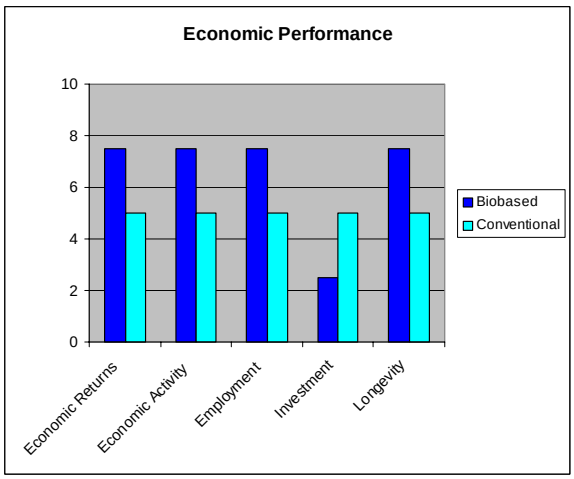
The "Interpretation" step is designed to examine and analyze the results of the assessment in order to reach conclusions and generate recommendations for decision-makers, consistent with the goal and scope defined in Step 1. In any conclusions and recommendations, it is important to clearly differentiate between the actual results of the SAFT assessment, and other work that reaches conclusions or recommendations based on factors such as technical feasibility/ performance, economic analyses, etc.

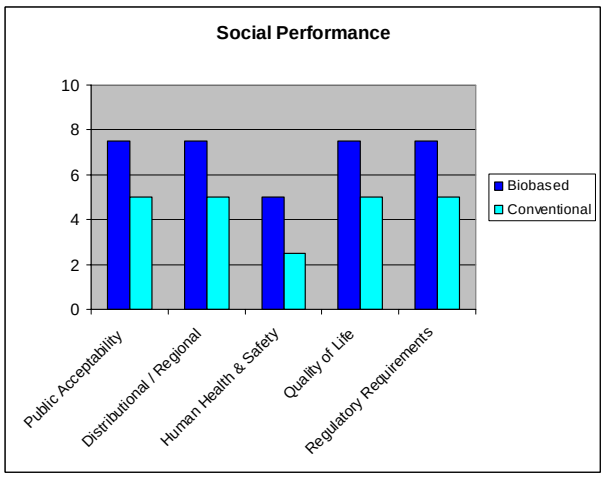
The SAFT Excel-based tool includes some scoring mechanisms to allow for easier interpretation of assessment results. It is important to note that each impact category is weighted equally. It is also important to consider both the overall results of the assessment as well as the summary results available via the tool.

Examples of the tool's graphical representation of results are shown below.









The graphical representation of results should be interpreted and communicated with caution. Note this is one input into decision-making; be wary of relying too much on the results of a level 1, screening assessment. Some of the comments captured in the tool (e.g., key assumptions) should be included in any communication of graphical results.

The interpretation step may involve an iterative process of reviewing and revising preceding steps (e.g., Goal and Scope, System and Baseline, Selecting Team, nature and quality of the data and information used) to better align the Results and the Goal and Scope of the assessment.

STEP 7: DOCUMENT AND USE RESULTS

It is important to document the results of the assessment in a fair, complete and accurate manner. The extent and rigour of the documentation should be consistent with the Goal and Scope established in Step 1, and the level of assessment required (see Table 1). At a minimum for all levels of assessment, a short report should be created that includes goal and scope, results (i.e., SAFT Excel-based tool printouts), conclusions and recommended next steps or action items. Areas of potential concern and areas where more information is required should be highlighted. More detail should be included for reports at higher levels per Table 1. Any supporting documentation used to back up the assessment should be referenced or included.

The results, data, methods, assumptions and limitations should be transparent and presented in sufficient detail to allow the reader to comprehend the complexities and trade-offs inherent in the assessment. The report should also allow the results and interpretation to be used in a manner consistent with the goals of the assessment.

It is particularly important to document significant limitations and assumptions with some explanation or justification. For example, these might include, but are not limited to:

- Key assumptions;
- Significant data gaps;
- Life cycle stages not considered; and
- Important elements of system or baseline not included.

It will often be useful to compare the results of the SAFT assessment with other similar assessments or analyses to help understand similarities and differences in the results. In addition, the outputs of other sustainability tools (e.g., LCA) could be used as inputs to the SAFT assessment.

Finally, it should be noted that it is unlikely you will arrive at exactly the same result each time you repeat a SAFT assessment for a specific biobased product or technology. More information might become available over time. Also, different teams will have various information, perspectives, values or priorities and consequently might not rate impacts and benefits in the same way.

OPTIONAL REVIEW PROCESS

Having someone review your SAFT assessment results is not always required, but as advisable for a number of reasons:

- Increase credibility of the assessment results (if use third party, independent reviewer);
- Ensure consistency between assessments;
- Double check results in cases of complex assessments; and
- Incorporate specific expertise (may be available for limited time commitment of review process but not be available for entire assessment process).

Depending on the level of assessment, the levels of review outlined in Table 3 are recommended. If you are completing a Level 1 Assessment, having a colleague or supervisor who is familiar with the SAFT methodology review your results will help to ensure the review is unbiased, and fairly considers the full scope of environmental, economic and social considerations. In a Level 2 Assessment, it may be beneficial to have an unrelated peer (colleague who was not involved directly in the development project) review your assessment findings. Finally, with Level 3 Assessments where the whole life cycle of the value chain was considered, where there is wide scale market applicability, or where the size of investment is large, having a third party independent reviewer (someone from a different organization who was not involved in the development project) may enhance the credibility and transparency of your results.

Table 3: Potential Level of Review Relative to Level of Assessment

Level of Assessment	Level 1	Level 2	Level 3
Level of Review	First Party (colleague)	Second Party (unrelated peer)	Third Party (external)

APPENDIX 1: EXAMPLES OF OTHER SD TOOLS

As discussed earlier, SAFT should not be used as the only sustainability assessment conducted on a new biobased product or technology. Using SAFT to identify potential issues with a biobased product or technology is not sufficient to ensure all risks or benefits are managed effectively. Users are encouraged to consider the use of other tools or methodologies that could complement SAFT.

Other tools or concepts that could complement SAFT are briefly described below.[4] This is not a comprehensive list, but provides some important examples.

Design for Environment or Eco-design

Design for environment (DfE) entails the integration of environmental considerations into the product design and development process.[5] Companies use DfE tools and techniques to improve the environmental performance of products while reducing costs, improving competitiveness, and stimulating innovation. Successful DfE practices in product design and development balance environmental considerations with cost, performance, safety, functionality and quality criteria.

Eco-efficiency

Eco-efficiency can be broadly defined as the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the Earth's estimated carrying capacity[6].

It is important to recognize that eco-efficiency only includes two of the three components of sustainable development: it brings together environment and economy, but does not deal with social issues. It is also important to consider that gains in efficiency may be accompanied by increases in production, deepening the environmental footprint of the activity. It is important to consider absolute impacts.

Ecological Footprint

The ecological footprint is an accounting tool for ecological resources. Categories of human consumption are translated into areas of productive land required to provide resources and assimilate waste products. The ecological footprint is expressed in "global hectares." Each unit corresponds to one acre of biologically productive space with "world average" productivity. Ecological footprint can be summarized as a measure of the sustainability of our lifestyles.[7]

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[4] Most of these descriptions (with the exception of Life Cycle Costing, TEAM SMART, and The Natural Step Framework) are taken from Five Winds International and Pollution Probe, 2004: *Tools and Concepts for Environmental Sustainability - Environmental Risk Assessment.* Published July 2004 to support Pollution Probe's Policy Framework for Environmental Sustainability Project. Available at http://www.fivewinds.com/publications/publications.cfm

[5] The term Design for Environment is used in this document. Terms such as Eco-Design, Green Design and Environmentally Conscious Design are also used throughout industry. The term Sustainable Design is also used by some companies, but frequently avoids addressing the social component of sustainability.

[6] World Business Council for Sustainable Development (WBCSD) definition of eco-efficiency. www.wbcsd.org

[7] Mathis Wackernagel and William Reese. University of British Columbia. www.ire.ubc.ca/ecoresearch/ecoftpr.html

Environmental Impact Assessment

Environmental impact assessment (EIA) is the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made.[8] In Canada, EIA is applied to development proposals or projects as defined under the *Canadian Environmental Assessment Act* (CEAA). A related methodology, strategic environmental assessment, is applied to policies, programs and plans. It is generally recognized that both processes are important and should operate in a complementary fashion. EIA is frequently described as a planning tool that contributes to sustainable development. This is one of the purposes stated in the CEAA.

Environmental Risk Assessment

Environmental risk assessment (ERA) involves the examination of risks resulting from natural events (flooding, extreme weather events, etc.), technology, practices, processes, products, agents (chemical, biological, radiological, etc.) and industrial activities that may pose threats to ecosystems, animals and people. Environmental health risk assessment addresses human health concerns and ecological risk assessment addresses environmental media and organisms. ERA is predominantly a scientific activity and involves a critical review of available data for the purpose of identifying and possibly quantifying the risks associated with a potential threat.

Industrial Ecology

Operating from the premise that in natural systems there is no waste, industrial ecology (IE) is a theoretical framework to examine environmental and efficiency flaws in existing industrial operations, to guide the development of new systems. One of the goals of IE is to model industrial systems on natural ecosystems, in which waste products from one process are inputs for another.[9] An industrial system of this type will reduce environmental risk, because the underlying causes will have been minimized or eliminated at the design stage.

Life Cycle Assessment

Life cycle assessment (LCA) is a decision making tool to identify environmental burdens and evaluate the environmental consequences of a product, process or service over its life cycle from cradle to grave. LCA has been standardized by the International Organization for Standardization (ISO) and forms the conceptual basis for a number of management approaches that consider a product across its life cycle, covering resource acquisition, product manufacturing, use and end of life.

Life Cycle Costing

Life Cycle Costing is a process to determine the sum of all the costs (i.e. “cradle to grave”) associated with an asset [or project or activity] …, including acquisition, installation, operation, maintenance, refurbishment and disposal costs. In the past, comparisons of … alternatives, whether at the concept or detailed design level, have been based mainly on initial capital costs. However, with growing pressure to achieve better outcomes …, ongoing operating and maintenance costs must be considered as they consume most resources over the asset’s service life. Life Cycle Costing forms an input to evaluation processes such as Value Management, Economic Appraisal and Financial Appraisal.[10]

[8] IAIA and IEA. *Principles of Environmental Impact Assessment Best Practice*. www.iaia.org.
[9] The EcoDesign Resource Society (EDRS). www.vcn.bc.ca/edrs/resources/indust_ecol.html.
[10] NSW Government Asset Management Committee, www.gamc.nsw.gov.au/tam/default.asp?PageID=82

Life Cycle Management

Life cycle management (LCM) is a flexible integrated framework of concepts, techniques and procedures used to address environmental, economic, technological and social aspects of products and organizations in order to achieve continuous environmental improvement from a life cycle perspective.[11]

Precautionary Principle

The 1992 United Nations Conference on the Environment and Development defined the precautionary principle in the statement, "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[12]

The Wingspread 1998 conference of activists, scholars, scientists, and lawyers released an alternative definition stating, "When an activity raises threats of harm to human health, or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically." [13]

Stakeholder Engagement

"Stakeholders" can be defined as those groups who impact and/or are impacted by the company and its activities.[14] Corporations are recognizing that their stakeholders comprise a much larger number of groups than previously understood. Over the last decade, the definition of "stakeholder" has expanded beyond the traditional groups to include social activists, communities, suppliers and other special interest groups.

Stakeholders have become more global in their reach and have a better understanding of business than ever before. Generally, stakeholders are demanding more global transparency, and many want not only to be informed of a company's activities and performance, but also to be involved in setting social and environmental performance objectives. Effective engagement of these various stakeholders is often cited as a key component of a company's overall environmental or sustainability strategy.

Some believe that stakeholder engagement is the foundation of the corporate social responsibility (CSR) movement. The Conference Board of Canada defines CSR as "the overall relationship of the corporation with all of its *stakeholders*. These include customers, employees, communities, owners/investors, government, suppliers and competitors. Elements of social responsibility include investment in community outreach, employee relations, creation and maintenance of employment, environmental stewardship and financial performance." Not only is stakeholder engagement a key part of CSR, but many companies agree that effectively engaging stakeholders is critical to keeping a pulse on society's expectations of the business community.

The Natural Step Framework for Sustainability

The Natural Step (TNS) Framework is a science and systems-based approach to organizational planning for sustainability. It provides a practical set of design criteria that can be used to direct social, environmental, and economic actions. The TNS Framework is fundamentally based on both an integrated assessment of current economic, social and ecological dynamics, and on the implications of

[11] SETAC Working Group LCM, 2001.
[12] NERAM. The Precautionary Principle in Canada. www.neram.ca/Pages/pp/ppweb.htm.
[13] Myers, Nancy. Raffensperger, Carolyn. Tickner, Joel. The Precautionary Principle in Action — A Handbook
[14] Stakeholder Engagement Introduction. Business for Social Responsibility. www.bsr.org/BSRResources/IssueBriefDetail.cfm?DocumentID=48813.

present trends for human society. The approach was developed in the late 1980s in response to growing concerns about the public health problems resulting from increasing toxins in the environment and current societal resource use practices. The TNS Framework describes core guiding principles for moving toward sustainability. It is intended to assist decision-makers by providing a pragmatic analytical tool for understanding and integrating sustainability principles into complex organizations.[15]

[15] The Natural Step Framework http://www.naturalstep.ca/framework.html

Canada

SAFT Sustainability Assessment Tool for Biobased Products and Technologies

Version 1.2
6-Apr-06




Read Instructions | Begin Assessment | View Results | Improve Results

Developed by: Five Winds International

Instructions

Users of this tool should consult the document "Sustainability Assessment Framework and Tool (SAFT) for Biobased Products and Technologies" for important background information and context **before using this Tool**. This document is available from Matthew Schacker (Environment Canada) or can be downloaded from the CBIN web site at www.cbin.gc.ca/KeyDocs-e.html. Note that using this tool is only 1 step in a multi-step process (see Figure below).

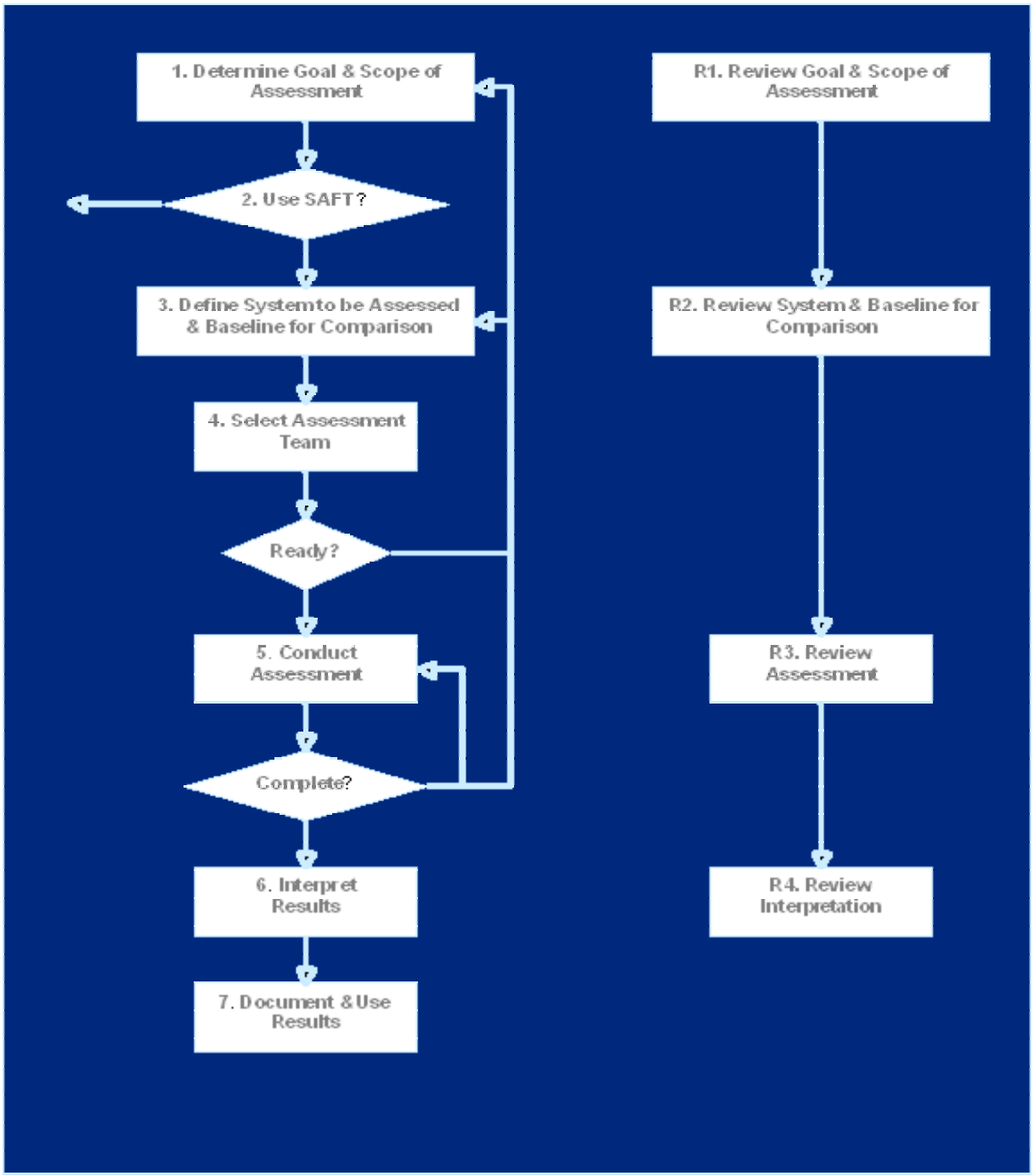
Enabling Macros
If you were asked to enable macros and you did not enable macros when opening the tool; close the tool and reopen it, then select "Enable Macros" when asked. You may need to change your Excel security settings by going into the Tools menu and selecting Options; click on the Security tab and then the Macros Security button; change your setting to Medium; click OK; and enable macros when you open the tool.

The SAFT Excel-based tool includes a series of questions about the environmental, economic and social impacts and benefits of the biobased product or technology system and baseline. You should respond to each question even if your feel the question is not applicable to your situation. Each question represents one of approximately 20 assessment categories and will help you systematically consider the sustainability impacts and benefits associated with the biobased product or technology being assessed.

Use the SAFT Excel-based tool to respond to each question. This version of SAFT supports a qualitative assessment; future versions of SAFT may incorporate quantitative assessment. The following steps should be used with the tool:

- **Review the assessment categories, the corresponding question and scoring guidance**. Scoring guidance is easily accessible by clicking on the impact category name in the first column of the "Assessment" spreadsheet. The scoring guidance includes important information about what the question means and what the various scoring levels mean (e.g., not applicable, none, low, medium, high, very high).
- Consider **what life cycle stages apply** to the system and baseline. It is not always necessary to consider all life cycle stages. However, if you omit some, you should be prepared to explain or justify why they are not significant to the assessment (e.g. identical between system and baseline).
- **Score the System and Baseline** for the applicable life cycle stages.
- If necessary, **add comments to qualify your selection**. Documenting the thought process behind each selection may be useful when it comes time to communicate the results or to repeat the assessment at a later stage in development of the biobased product or technology. Some examples of information you may want to note in the comments field include:
    - Level of confidence in the selection;
    - Level of documentation or data supporting the selection;
    - Any assumptions used;
    - Area of divergence in opinion in among team members;
    - Area of positive impact (as impact categories are designed to score negative impacts, or the "unsustainability" of a product or technology).

Making Changes to the SAFT Excel-based Tool
Depending on the details of your assessment (e.g. Goal & Scope, System, Baseline, etc.), there may be a need to make changes to the SAFT Excel-based tool. The most likely change would be to add environmental, economic or social impact categories. To improve consistency between assessments, making changes to the Excel-based tool is not recommended. Note that the Excel-based tool is password protected. To make changes, first unprotect the relevant worksheet(s) by going into the Tools menu and selecting Protection; then select Unprotect Sheet; enter the password SAFT (all uppercase); and click OK. After you have finished making changes to the tool, to avoid problems it is advisable to protect the tool again by going into the Tools menu; selecting Protection; then select Protect Sheet; enter the password SAFT (twice to confirm); and click OK.


1. Determine Goal & Scope of Assessment
2. Use SAFT?
3. Define System to be Assessed & Baseline for Comparison
4. Select Assessment Team
Ready?
5. Conduct Assessment
Complete?
6. Interpret Results
7. Document & Use Results
R1. Review Goal & Scope of Assessment
R2. Review System & Baseline for Comparison
R3. Review Assessment
R4. Review Interpretation

Assessment Set Up	
	Enter Assessment specific data below
Name of Overall Assessment	e.g. Comparison of Biotech Feedstock to Conventional Feedstock
Name of System being Assessed	e.g. Biobased
Name of Baseline Compared Against	e.g. Conventional
Goal & Scope Statement	*State the intended use of the results, the reasons for carrying out the assessment and the intended audience; i.e. to whom the results of the assessment will be communicated.*
Assessment Team	
Subject Matter Expert(s)	
>System	*Example data only*
>Baseline	*Example data only*
>Others	*Example data only*
Sustainability Specialist(s)	*Example data only*
Others	*Example data only*
Date of Assessment	31-Mar-06
Last Update	6-Apr-06

System & Baseline Figures

This worksheet is provided to capture System and Baseline Figures for the SAFT assessment.

These diagrams should be included here (copy and paste from another source as appropriate).

Assessment for e.g. Comparison of Biotech Feedstock to Conventional Feedstock

Home Reset

Impact Category	Key Question	e.g. Biobased Score				e.g. Conventional Score				Comments on System or Baseline Score
Environmental		Raw Materials	Manufacturing	Use	End of Life	Raw Materials	Manufacturing	Use	End of Life	
Ecosystem Integrity	What is the potential threat on natural ecosystem structure, function, lifecycles and integrity (e.g., fragmentation of ecosystems, impact on interspecies relationships, downstream effects on parks, protected areas and wilderness)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Confidence in the selection; Documentation or data supporting the selection; Assumptions used; Divergences in opinion in among team members; Positive impacts
Biodiversity & Wildlife	What is the potential for the system or baseline to have a negative impact on biodiversity and/or wildlife (e.g., intensified monoculture, effects on rare, threatened or endangered species, displacement of native species)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Air Quality	What is the potential for air quality to be negatively impacted by the system or baseline (e.g., pesticide use, vehicle emissions)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Greenhouse Gases	What is the potential for greenhouse gas emissions to be increased by the system or baseline?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Water Quality	What is the potential for water sources (ground water or surface water) to be negatively impacted over the life cycle of the system or baseline (e.g., pesticide or nutrient effluent, excessive water use)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Land Use and Impacts	What is the potential for land use to be shifted from agricultural production for food to other uses (e.g., energy feedstock, displacement of land uses, nature and extent of land use, soil quality and productivity)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Resource & Material Intensity	What intensity of raw materials or resource inputs are required for this system or baseline over its life cycle (e.g., energy use, pesticide or herbicide use, embodied energy)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Waste	What intensity of toxic products and releases are involved over the life cycle of the system or baseline (e.g., pesticide use, chemical releases, hazardous waste, landfill requirements)?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Economic		Raw Materials	Manufacturing	Use	End of Life	Raw Materials	Manufacturing	Use	End of Life	
Economic Returns	Is the system or baseline economically attractive?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Economic Activity	What is the potential for the system or baseline to contribute to economic activity?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Employment	What is the potential for the system or baseline to contribute to employment?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Investment	What is the scale of investment required for the system or baseline, relative to potential benefits?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Longevity	What is the potential for the system or baseline to exhibit longevity?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Social		Raw Materials	Manufacturing	Use	End of Life	Raw Materials	Manufacturing	Use	End of Life	
Public Acceptability	What is the potential for the system or baseline to have a negative impact on public acceptability?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Distributional / Regional	What is the potential for the system or baseline to have negative distributional / regional impacts?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Human Health & Safety	Is there potential for large scale and irreversible impacts to human health such as risk of transfer of disease or traits to humans?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	
Quality of Life	What is the potential for the system or baseline to have a negative impact on quality of life?	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	Choose:	

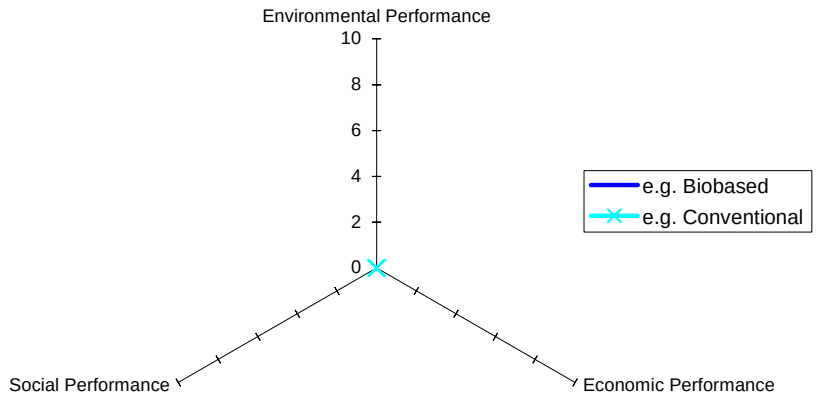
Results for e.g. Comparison of Biotech Feedstock to Conventional Feedstock

Home

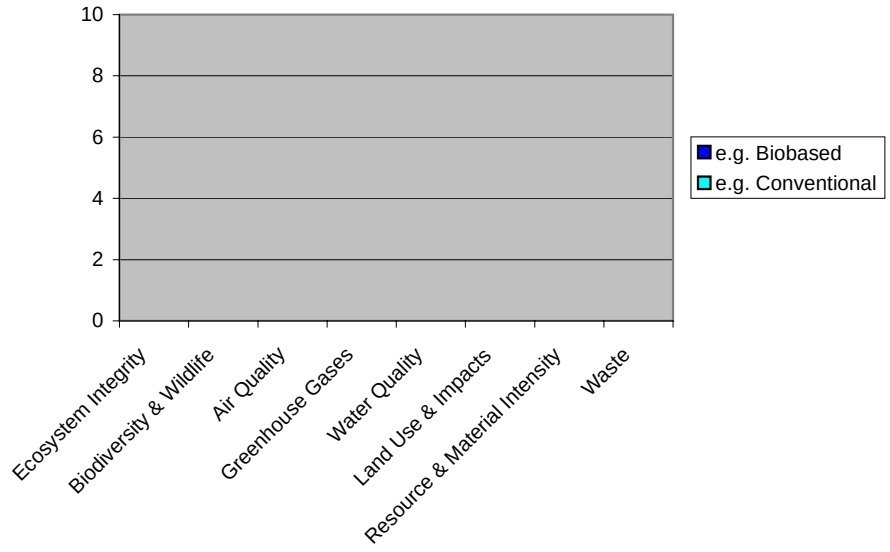
Impact Category	e.g. Biobased				Goal	e.g. Conventional			
	LC Stages Scored	Max Possible Score	Actual Score	Actual Score %		LC Stages Scored	Max Possible Score	Actual Score	Actual Score %
Environmental									
Ecosystem Integrity	0	0	0	n/a	–	0	0	0	n/a
Biodiversity & Wildlife	0	0	0	n/a	–	0	0	0	n/a
Air Quality	0	0	0	n/a	–	0	0	0	n/a
Greenhouse Gases	0	0	0	n/a	–	0	0	0	n/a
Water Quality	0	0	0	n/a	–	0	0	0	n/a
Land Use & Impacts	0	0	0	n/a	–	0	0	0	n/a
Resource & Material Intensity	0	0	0	n/a	–	0	0	0	n/a
Waste	0	0	0	n/a	–	0	0	0	n/a
Economic									
Economic Returns	0	0	0	n/a	+	0	0	0	n/a
Economic Activity	0	0	0	n/a	+	0	0	0	n/a
Employment	0	0	0	n/a	+	0	0	0	n/a
Investment	0	0	0	n/a	–	0	0	0	n/a
Longevity	0	0	0	n/a	+	0	0	0	n/a
Social									
Public Acceptability	0	0	0	n/a	–	0	0	0	n/a
Distributional / Regional	0	0	0	n/a	–	0	0	0	n/a
Human Health & Safety	0	0	0	n/a	–	0	0	0	n/a
Quality of Life	0	0	0	n/a	–	0	0	0	n/a

Environmental Performance	n/a	n/a
Economic Performance	n/a	n/a
Social Performance	n/a	n/a

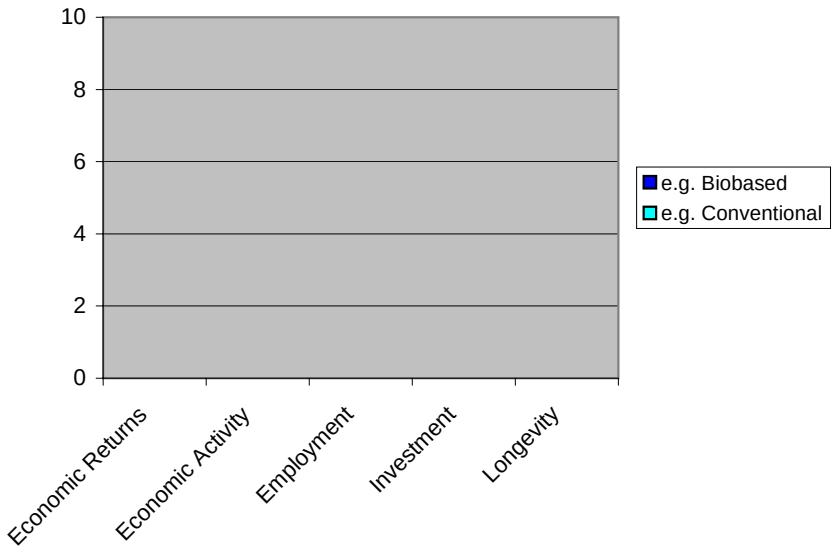
Sustainability Performance



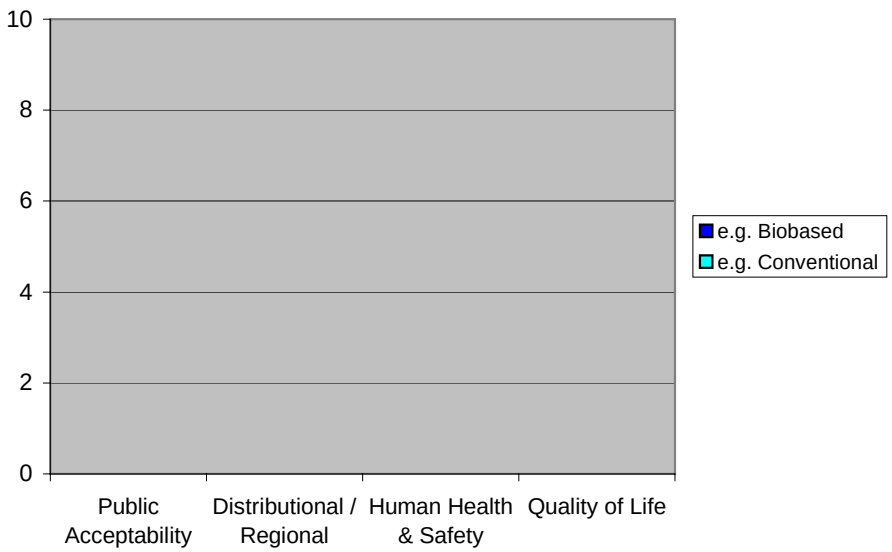
Environmental Performance

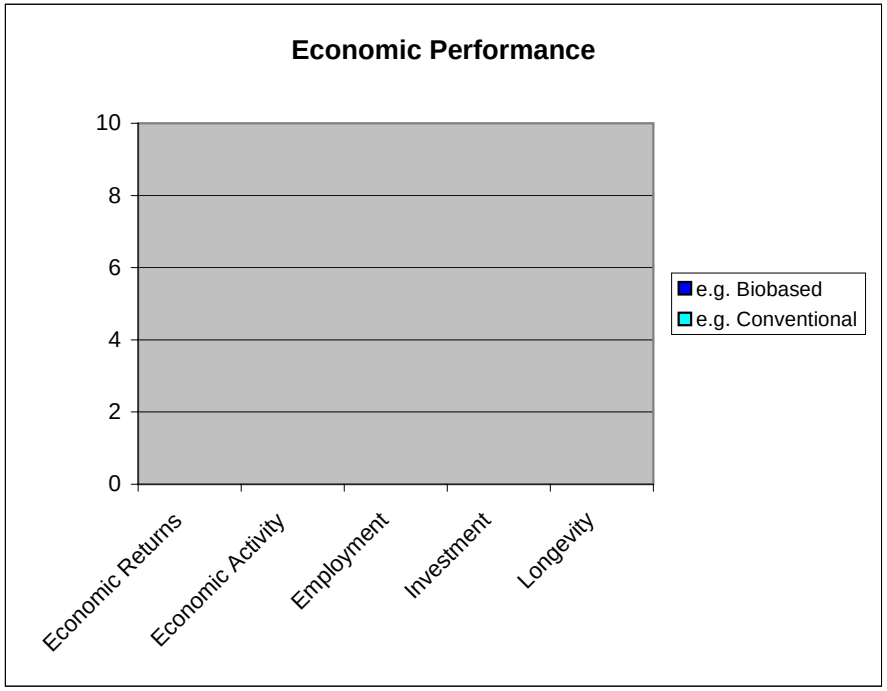


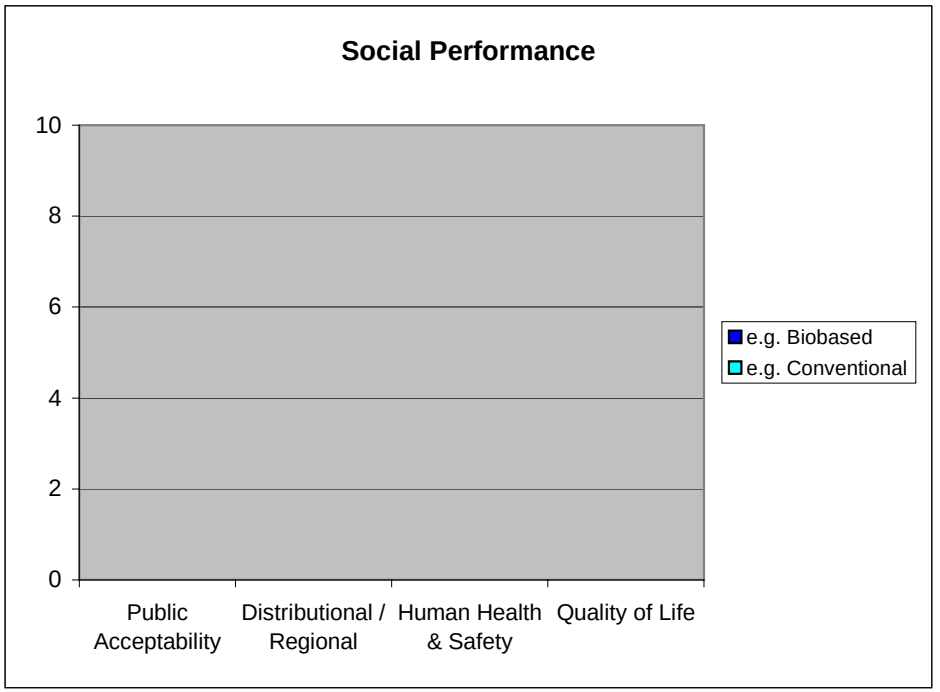
Economic Performance



Social Performance




Economic Performance
10
8
6
4
2
0
Economic Returns
Economic Activity
Employment
Investment
Longevity
e.g. Biobased
e.g. Conventional


Social Performance
10
8
6
4
2
0
Public Acceptability
Distributional / Regional
Human Health & Safety
Quality of Life
e.g. Biobased
e.g. Conventional

Next Steps & Actions

This worksheet is provided to capture next steps and actions that result from the SAFT assessment.

	Action Item	Who will do it?	Schedule	Status
1	*Example Action Item*	*e.g. John Doe*	31-Jul-06	example status of action; example status of action
2				
3				
4				
5				
6				
7				
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11				
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20				

Ecosystem Integrity

Back to Assess

Key Question

What is the potential threat on natural ecosystem structure, function, lifecycles and integrity (e.g., fragmentation of ecosystems, impact on interspecies relationships, downstream effects on parks, protected areas and wilderness)?

Overview

Fragmentation of ecosystems, altered structure and function of ecosystems, impact on interspecies relationships, downstream effect on parks, protected areas & wilderness *over the long term, consider secondary and tertiary impacts

- When scoring ecosystem integrity consider:
  - sensitive systems including endangered species
  - effect on protected areas
  - interference with movement of native or migratory species (wildlife corridors)
  - amount of habitat disturbed (total area)
  - temporal aspect of disturbance (permanent versus temporary, if temporary, how long)
- Sensitive systems such as those with endangered species should be scored higher.

Metric	Unit	Scoring Guidance
	None (N)	No impact
Potential Impact	**Low (L)**	Little disturbance of ecosystem integrity (including protected areas or species) over existing levels. (Temporary Impact)
	Medium (M)	Some disturbance of ecosystem integrity (including protected areas or species). Little permanent change in the existing quality or ecological function of natural areas. (Temporary Impact)
	High (H)	Moderate disturbance of ecosystem integrity (including protected areas or species). Impacts can be partially or completely mitigated and will not affect existing functions over the long term. (Temporary Impact)
	Very High (VH)	Significant disturbance of ecosystem integrity (including protected areas or species). Significant net loss of ecological functions that cannot be mitigated. (Permanent Impact)

References:

Canadian Environmental Assessment Agency (2000). Specification of Sustainability-Based Environmental Assessment Decision Criteria and Implications for Determining “Significance” In Environmental Assessment. Available at: http://www.ceaa-acee.gc.ca/015/0002/0009/index_e.htm

Finnish Environment Institute (2001). Manual for Environmental Impact Assessment in Lithuania.

I. B. Marshall and P. H. Schut (1999): A National Ecological Framework for Canada. Available at: http://sis.agr.gc.ca/cansis/nsdb/ecostrat/intro.html

Institute of Ecology and Environmental Management (2002). Guidelines for Ecological Impact Assessment. Available at: http://www.ieem.org.uk/ECIA.htm

IUCN-The World Conservation Union (1998). Biodiversity and Impact Assessment.

Biodiversity & Wildlife

Back to Assess

Key Question

What is the potential for the system or baseline to have a negative impact on biodiversity and/or wildlife (e.g., intensified monoculture, effects on rare, threatened or endangered species, displacement of native species)?

Overview

- When scoring impacts to biodiversity and/or wildlife consider:
  - intensified monoculture - promoting genetic uniformity
  - effects on rare, threatened or endangered species
  - displacement of native species
  - habitat loss due to extension of agriculture onto marginal lands
  - risks of invasiveness
  - impacts on beneficial species
  - effect on populations' fecundity
  - integrity of resident populations
  - effects on migration
  - long term secondary and tertiary impacts
-

Metric	Unit	Scoring Guidance
	None (N)	No impact
Potential Impact	**Low (L)**	Little disturbance of biodiversity and/or wildlife (including protected areas or species) over existing levels. (Temporary Impact)
	Medium (M)	Some disturbance of biodiversity and/or wildlife (including protected areas or species). Little permanent change in the existing quality or ecological function of natural areas. (Temporary Impact)
	High (H)	Moderate disturbance of biodiversity and/or wildlife (including protected areas or species). Impacts can be partially or completely mitigated and will not affect existing functions over the long term. (Temporary Impact)
	Very High (VH)	Significant disturbance of biodiversity and/or wildlife (including protected areas or species). Significant net loss of ecological functions that cannot be mitigated. (Permanent Impact)

Air Quality

Back to Assess

Key Question

What is the potential for air quality to be negatively impacted by the system or baseline (e.g., pesticide use, vehicle emissions)?

Overview

- When scoring impacts to air quality consider sources and receptors:
  - mobile sources such as vehicle emissions
  - stationary sources such as boilers burning fossil fuels
  - pesticide use / dispersion
  - the number of people in the surrounding area in proportion to their distance from air pollution source
  - the presence of sensitive receptors such as schools, hospitals, commercial and residential areas
- Examples of air emissions include particulates, aerosols, acid precipitation precursors, smog precursors, ozone depleting substances, air toxics

Metric	Unit	Scoring Guidance
Potential Impact	None (N)	No impact
	Low (L)	Little decrease in air quality over existing levels.
	Medium (M)	Some decrease in air quality that affects minor number of people (<100)
	High (H)	Moderate decrease in air quality that affects moderate number of people (>100 and <1000)
	Very High (VH)	Significant decrease in air quality that affects significant number of people (>1000)

Greenhouse Gases (GHGs)

Back to Assess

Key Question

What is the potential for greenhouse gas emissions to be increased by the system or baseline?

Overview

- When scoring impacts to greenhouse gas emissions consider:
  - mobile sources such as vehicle emissions
  - stationary sources such as boilers burning fossil fuels
- Examples of greenhouse gas emissions include carbon dioxide, methane, nitrous oxide, HFCs, PFCs and SF6.

Metric	Unit	Scoring Guidance
Potential Impact	None (N)	No impact (< 1 Mtonne)
	Low (L)	Little increase in GHG emissions over existing levels (> 1 Mtonne and < 5 Mtonne).
	Medium (M)	Some increase in GHG emissions over existing levels (> 5 Mtonne and < 10 Mtonne).
	High (H)	Moderate increase in GHG emissions over existing levels (> 10 Mtonne and < 20 Mtonne).
	Very High (VH)	Significant increase in GHG emissions over existing levels (> 20 Mtonne).

Water Quality

Back to Assess

Key Question

What is the potential for water sources (ground water or surface water) to be negatively impacted over the life cycle of the system or baseline (e.g., pesticide or nutrient effluent, excessive water use)?

Overview

Water based natural system disturbance considers impacts to ecosystems including aquatic life, habitat, vegetation and waterways.

- When scoring impacts to water sources consider:
  - impact on upstream areas that in turn could affect aquatic or riparian / wetland zones downstream.
  - sensitive systems including endangered species
  - effect on protected areas
  - area of compensatory habitat created
  - change in abundance or diversity of indigenous fish species
  - interference with movement of native or migratory species
  - amount of habitat disturbed (total area)
  - temporal aspect of disturbance (permanent versus temporary, if temporary, how long)
  - effect of noise, vibration and water quality, temperature, etc. on aquatic natural systems
  - degree of nutrient loading / level of Total Dissolved Solids (TDS)
  - changes to water BOD
  - eutrophication (algal bloom) potential caused by fertilizer run-off
  - effects on water potability
  - contamination of ground water / aquifers (e.g. agricultural run-off, pesticides, fertilizers, etc.)
  - water availability for other uses
- Sensitive systems such as those with endangered species should be scored higher.

Metric	Unit	Scoring Guidance
	None (N)	No impact
Potential Impact	**Low (L)**	Little disturbance of water based natural systems (including protected areas or species) over existing levels. (Temporary Impact)
	Medium (M)	Some disturbance of water based natural systems (including protected areas or species). Little permanent change in the existing quality or ecological function of natural areas. (Temporary Impact)
	High (H)	Moderate disturbance of water based natural systems (including protected areas or species). Impacts can be partially or completely mitigated and will not affect existing functions over the long term. (Temporary Impact)
	Very High (VH)	Significant disturbance of water based natural systems (including protected areas or species). Significant net loss of ecological functions that cannot be mitigated. (Permanent Impact)

Land Use and Impacts

Back to Assess

Key Question

What is the potential for land use to be shifted from agricultural production for food to other uses (e.g., energy feedstock, displacement of land uses, nature and extent of land use, soil quality and productivity)?

Overview

- When scoring impacts to land consider:
  - soil quality and productivity
  - soil erosion
  - impacts on vegetation
  - impacts on landscape
  - nature and extent of land use (total area)
  - displacement of land uses (e.g. risk to organic and traditional agricultural uses)
  - temporal aspect of disturbance (permanent versus temporary, if temporary, how long)
- Sensitive systems such as those with endangered species should be scored higher.
- Potential to create new habitat, or improve existing habitat should be considered as a positive environmental / social aspect.

Metric	Unit	Scoring Guidance
	None (N)	No impact
Potential Impact	**Low (L)**	Little disturbance of land. (Temporary Impact)
	Medium (M)	Some disturbance of land. Little permanent change in the existing quality of soil, productivity, existing land use / arability. (Temporary Impact)
	High (H)	Moderate disturbance of land. Impacts can be partially or completely mitigated and will not affect existing functions / arability over the long term. (Temporary Impact)
	Very High (VH)	Significant disturbance of land. Significant net loss of functions / arability that cannot be mitigated. (Permanent Impact)

Resource & Material Intensity

Back to Assess

Key Question

What intensity of raw materials or resource inputs are required for this system or baseline over its life cycle (e.g., energy use, water use, pesticide or herbicide use, embodied energy)?

Overview

- When scoring material intensity consider:
  - using purpose grown crops and virgin materials tends to have greater impacts on natural resources than using residues and recycled materials
  - materials that are utilized within a closed-loop system help to minimize constraints on natural resources.
  - materials that may be recycled for other uses also help to minimize constraints on natural resources.
  - energy intensity
  - material intensity
  - water consumption
  - level of resource use
  - renewability of feedstock inputs
  - renewable vs. non-renewable resource use

Metric	Unit	Scoring Guidance
Input Intensity	None (N)	No impact; no concerns with input renewability or availability.
	Low (L)	Little intensity of raw materials or resource inputs required, or little concerns with input renewability or availability.
	Medium (M)	Some intensity of raw materials or resource inputs required, or some concerns with input renewability or availability.
	High (H)	Moderate intensity of raw materials or resource inputs required, or moderate concerns with input renewability or availability.
	Very High (VH)	Significant intensity of raw materials or resource inputs required, or significant concerns with input renewability or availability.

Waste

Back to Assess

Key Question

What intensity of hazardous/toxic products and releases are involved over the life cycle of the system or baseline (e.g., pesticide use, chemical releases, hazardous waste, landfill requirements)?

Overview

- Examples of hazardous/toxic products and releases over the life cycle may include: pesticide use, chemical releases, hazardous waste, etc.

Metric	Unit	Scoring Guidance
Potential Impact	None (N)	No impact
	Low (L)	Little use or release of hazardous/toxic materials that require special handling.
	Medium (M)	Some use or release of hazardous/toxic materials that require special handling.
	High (H)	Moderate use or release of hazardous/toxic materials that require special handling.
	Very High (VH)	Significant use or release of hazardous/toxic materials that require special handling.

Economic Returns

Back to Assess

Key Questions

Is the system or baseline economically attractive?

Overview

- When scoring economic returns consider:
  - Economic viability (IRR, NPV, etc.)
  - Reliance on unproven business/commercial expertise (e.g. marketing, sales, operations, financing, etc.)

Metric	Unit	Scoring Guidance
Potential Benefit	None (N)	No economic returns.
	Low (L)	Low economic returns in the short- to medium- term, diminishes over long-term.
	Medium (M)	Some economic returns over the short- to medium-term, diminishes over long-term.
	High (H)	High economic returns over the short- to medium-term, uncertain over long-term.
	Very High (VH)	Very high economic returns over the long-term.

Economic Activity

Back to Assess

Key Question

What is the potential for the system or baseline to contribute to economic activity?

Overview

- When scoring economic activity, consider:
  - Effect on GDP
  - Potential Revenues - public, private
  - Net Business Creation
  - Regional economic development / loss
  - Structural impacts (sectoral shifts)

Metric	Unit	Scoring Guidance
Potential Benefit	None (N)	No impact; or negative impact.
	Low (L)	Little contribution to economic activity.
	Medium (M)	Some contribution to economic activity.
	High (H)	Moderate contribution to economic activity.
	Very High (VH)	Significant contribution to economic activity.

Employment

Back to Assess

Key Question

What is the potential for the system or baseline to contribute to employment?

Overview

- When scoring impact on employment, consider:
  - Changes in employment
  - Net job growth
  - Levels of pay
  - Expertise
  - Mix of jobs
  - Sectoral shifts

Metric	Unit	Scoring Guidance
Potential Benefit	None (N)	No impact; or negative impact.
	Low (L)	Little contribution to employment.
	Medium (M)	Some contribution to employment.
	High (H)	Moderate contribution to employment.
	Very High (VH)	Significant contribution to employment.

Investment

Back to Assess

Key Question

What is the scale of investment required for the system or baseline, relative to potential benefits?

Overview

- When scoring impact on investment consider:
  - Costs of inputs
  - Capital intensity
  - Public subsidies
  - R&D spending (public, private)
  - Technology and infrastructure development

Metric	Unit	Scoring Guidance
Potential Impact	None (N)	No impact
	Low (L)	Little investment (<$10 Million) required relative to potential benefits.
	Medium (M)	Some investment (~$25 Million) required relative to potential benefits.
	High (H)	Moderate investment (~$50 Million) required relative to potential benefits.
	Very High (VH)	Significant investment (>$100 Million) required relative to potential benefits.

Longevity

Back to Assess

Key Questions

What is the potential for the system or baseline to exhibit longevity?

Overview

- When scoring longevity consider:
  - Long-term prospects for product
  - Market 'staying power' of proponent and other key players in value chain
  - Security of supply (e.g. energy, feedstock, renewability of resource)
  - Customer demand (short-, medium- and long-term)

Metric	Unit	Scoring Guidance
Potential Benefit	None (N)	No potential for longevity (product, market or proponent).
	Low (L)	Little potential for longevity (product, market or proponent).
	Medium (M)	Some potential for longevity (product, market or proponent).
	High (H)	Moderate potential for longevity (product, market or proponent).
	Very High (VH)	Significant potential for longevity (product, market or proponent).

Public Acceptability

Back to Assess

Potential Key Questions

What is the potential for negative impacts on public acceptability?

Overview

- When scoring impacts to public acceptability consider:
  - Ethical concerns
  - Appropriateness and risks of GMOs, cloning, transgenic implanting
  - 'Ownership' and patenting of genes
  - Animal welfare and rights
  - Cultural / religious beliefs around genes, the essence of life and violation of the natural order
  - Access to information regarding GMO content

Metric	Unit	Scoring Guidance
Potential Impact	None (N)	No impact (No-sensitive issues)
	Low (L)	Little impact on public acceptability. (Issue for a few groups, but no key stakeholder groups affected)
	Medium (M)	Some impact on public acceptability. (Sensitive issue for a few groups, at least one key stakeholder group affected)
	High (H)	Moderate impact on public acceptability. (Sensitive issue for a number of groups, including some (more than one) key stakeholders)
	Very High (VH)	Significant impact on public acceptability. (Highly sensitive issue for a number of groups, including some (more than one) key stakeholders)

Distributional / Regional

Back to Assess

Key Question

What is the potential for the system or baseline to have negative distributional / regional impacts?

Overview

- When scoring distributional/ regional impacts consider:
  - Intergenerational effects
  - Equity
  - Structural shifts between sectors and regions
  - Destabilization
  - Social cohesion
  - Income levels
  - Poverty Issues
  - Distribution of power (e.g. corporate , individual)
  - Access to the product (i.e., affordability)

Metric	Unit	Scoring Guidance
Potential Impact to Product Access	None (N)	No impact
	Low (L)	Little distributional / regional impact (Partial and/or short-term)
	Medium (M)	Some distributional / regional impact (Limited over the short-term)
	High (H)	Moderate distributional / regional impact
	Very High (VH)	Significant distributional / regional impact

Human Health & Safety

Back to Assess

Key Question

Is there potential for irreversible impacts to human health such as risk of transfer of disease or traits to humans?

Overview

- When scoring impacts to human health and safety consider:
  - Potential health enhancement
  - Health impacts and threats
  - Life expectancy
  - Mortality
  - How product or technology may affect different age categories
  - Access to medical services
  - Food security
  - Distribution schemes facilitating new or additional exposure to the product or technology

Methodology

i For the system or baseline being assessed, identify and list all health and safety risks that are not captured by other impact categories. This risks may be associated with factors such as

- Risk or transfer of disease or traits to humans
- Threats to food security

Note that this is not an exhaustive list of potential risk factors.

ii For each identified risk, estimate both the probability (likelihood) of exposure and the consequence (severity) using the table below.

Probability		Consequence	
1 Very Low	Extremely unlikely that exposure would occur	1 Minor	Potential for minor injury or illness (no first aid).
2 Low	Unlikely that exposure will occur	2 Moderate	Minor injury, illness, or disease requiring first aid (no medical treatment).
3 Medium	Exposure is likely to occur	3 Major	Significant injury, illness or disease resulting in medical treatment.
4 High	Exposure is very likely to occur	4 Severe	Fatality or immediately dangerous to life or health.

iii Using your estimates of probability and consequence for each risk, use the Risk Rating Table below to determine a risk rating value.

Risk Rating Table

Probability \ Consequence	1	2	3	4
1	A	B	C	D
2	B	C	U	U
3	D	U	U	U
4	U	U	U	U

Risk Rating Value		Action
A	Negligible	Action not required
B	Very low	Action not normally required
C	Low	Action may be required
D	Medium	Additional actions should be in place and have been reviewed and found to be appropriate
U	Unacceptable	Controls should be implemented to achieve a risk rating of A, B, C, or D

iv Enter the highest risk rating (e.g. Negligible, Very Low, Low, Medium, Unacceptable, with Negligible being lowest and Unacceptable being highest) for the System or Baseline on the Assessment sheet. Keep in mind that risk rating may be affected by mitigation actions, which should included as part of the System or Baseline if applicable

v Repeat steps i through iv for both System and Baseline.

Quality of Life

Back to Assess

Key Question

What is the potential to have a negative impact on quality of life?

Overview

- When scoring impacts to quality of life consider:
  - Standard of living
  - Income and wealth creation
  - Cost of living
  - Effect on disposable income
  - Income levels
  - Leisure time
  - Changes in demographics
  - Influence on social values
  - Impacts on business conditions
  - Changes to employment rates

Metric	Unit	Scoring Guidance
Potential Impact	None (N)	No impact
	Low (L)	Little negative impact on the quality of life
	Medium (M)	Some negative impact on the quality of life
	High (H)	Moderate negative impact on the quality of life
	Very High (VH)	Significant negative impact on the quality of life