Designation: ~~E3066 – 16a~~ E3066 – 20

Standard Practice for Evaluating Relative Sustainability Involving Energy or Chemicals from Biomass[1]

This standard is issued under the fixed designation E3066; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This standard practice provides a science-based methodology for evaluating the relative sustainability of options involving energy or chemicals derived from biomass. Options may involve products, processes, or projects.

1.2 The methodology includes setting goals and objectives, identifying stakeholders, selecting appropriate indicators, and evaluating the relative sustainability of options where at least one option is available from biomass.

1.3 The objectives are to facilitate fair comparison of options, focus efforts on practical indicators reflecting stakeholder priorities, and support continual improvement for more sustainable outcomes.

1.4 The purpose of this standard practice is not to declare something as sustainable or not sustainable but to help users assess, compare, and rank options based on specific goals and objectives.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1705 Terminology Relating to Biotechnology

2.2 *ISO ~~Standards:~~Standard:*[3]

~~ISO 14040 Environmental Management—Life Cycle Assessment—Principles and framework~~

~~ISO 14044 Life Cycle Assessment—Requirements and Guidelines~~

ISO 13065 Sustainability Criteria for Bioenergy

3. Terminology

3.1 For general terminology, refer to Terminology E1705.

NOTE 1—The user is advised that the definitions used by various industries, marketers, and regulatory bodies can differ from those in this standard. It is the responsibility of the user to ensure that the terms used in a particular context are clearly understood.

3.2 *Definitions:*

3.2.1 *biomass, n*—substance wholly comprised of living or recently living (nonfossil) material.

3.2.1.1 *Discussion*—

[1] This practice is under the jurisdiction of ASTM Committee E48 on Bioenergy and Industrial Chemicals from Biomass and is the direct responsibility of Subcommittee E48.80 on Sustainability of Bioenergy and Industrial Chemicals from Biomass.

Current edition approved ~~Dec. 1, 2016~~May 1, 2020. Published ~~January 2017~~May 2020. Originally approved in 2016. Last previous edition approved in 2016 as ~~E3066~~E3066 – 16a.~~–16.~~ DOI: ~~E3066–16A.~~10.1520/E3066–20.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

Sometimes referred to as "renewable organic material," examples of biomass include whole or parts of plants, trees, aquatic organisms, animals, algae, and micro-organisms.

~~3.2.2 *continual improvement, n*—a systematic, iterative process of identifying and evaluating options and selecting those that provide incremental improvements toward achieving defined goals and objectives.~~

3.2.2 *context, n*—the historical conditions, trends, and other forces that influence or define the measurement and interpretation of environmental, economic, and social indicators in a specific place and time.

3.2.3 *continual improvement, n*—a systematic, iterative process of identifying and evaluating options and selecting those that provide incremental improvements toward achieving defined goals and objectives.

3.2.4 *indicator, n*—specific, science-based, observable, and measurable characteristic.

3.2.4.1 *Discussion*—

Indicators can be used to assess environmental, social, or economic conditions of a system, to assess effects of activities on phenomena of concern, or to monitor trends in conditions over time. **(1)**[4]

3.2.5 *measure, v*—quantify the size, amount, or degree using a science-based approach and appropriate unit(s).

3.2.6 *relative sustainability, n*—the result of a comparison of two or more options that enables the evaluation of costs, benefits, and trade-offs.

3.2.6.1 *Discussion*—

Relative sustainability involves a defined application of goals, objectives, and indicators within a specified context.

3.2.6.2 *Discussion*—

For additional information, see 4.2.3.

3.2.7 *science-based, adj*—applying principles and practices that employ the scientific method.

3.2.7.1 *Discussion*—

The scientific method is a process of testing a hypothesis based on evidence and typically involves objective observation, experiment, critical analysis, verification, ~~repetition,~~replication, and induction.

3.2.8 *stakeholder, n*—individual, group, or organization that can affect or be directly affected by the options being evaluated.

3.2.8.1 *Discussion*—

The identification of stakeholders depends on the specific product, process, or project, and its context. Stakeholders may vary over time and can include regulatory bodies, customers, neighbors, employees, suppliers, and surrogates.

3.2.9 *sustainability, n*—aspirational concept denoting the capacity to meet current needs while maintaining options for future generations to meet their needs. **(2); (3); (4)**

3.2.9.1 *Discussion*—

For additional information, see 4.2.1.

~~3.2.9 *relative sustainability, n*—a comparison of two or more options that enables the evaluation of costs, benefits, and trade-offs that apply goals, objectives, and indicators within a specified context.~~

~~3.2.9.1 *Discussion*—~~

~~for additional information see 4.2.3.~~

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *assessment, n*—collecting and analyzing data for the ~~indicators selected in an evaluation plan.~~selected indicators.

[4] The boldface numbers in parentheses refer to ~~a~~the list of references at the end of this standard.

3.3.2 *evaluation, n*—a systematic, iterative process for comparing options using prioritized science-based indicators and comparing the assessments while considering the trade-offs based on identified goals and boundary conditions.

3.3.2.1 *Discussion*—

Within this standard practice, the evaluation may be referred to as the "evaluation plan" or simply "the plan."

4. Discussion of Concepts

4.1 Concepts used in this practice can differ from their use in other sustainability certification standards and schemes.

4.2 *Evaluating Relative Sustainability*

4.2.1 Sustainability does not imply a steady state or an absolute value; for human activity to be "sustainable," change or adaptation over time is required. To make the concept of sustainability operational, objectives must be defined within a specified context, stakeholders engaged, and consistent approaches applied to facilitate comparable, science-based assessments (**2-5**).

4.2.2 Environmental, economic, and social changes are inevitable. Staying on course toward goals entails an iterative process and adaptation to changing contextual conditions.

4.2.3 Evaluation of relative sustainability is supported by science-based analysis of environmental, economic, and social indicators of conditions associated with the options under consideration. The evaluation process includes documenting costs, benefits, and trade-offs among selected environmental, economic, and social indicators.

4.3 *Context and Stakeholders*

4.3.1 Determining the context for evaluating the relative sustainability is a critical step. A decision or action that results in a more sustainable outcome under one set of conditions may not produce a more sustainable outcome under other conditions.

4.3.2 Defining context and identifying stakeholders depend on the proposed goals of an evaluation. Typically, the evaluation goals are directly linked to the options to be assessed. Objectives and context help establish the appropriate scope including the temporal and spatial boundaries. Assessments should focus on a scale that facilitates stakeholder engagement and enables researchers to collect and analyze data for activities that are causally linked to locally defined problems and observable values.

4.3.3 A clearly defined project purpose, addressing a clearly articulated problem, will help establish boundaries that facilitate constructive stakeholder engagement.

4.3.4 Stakeholder input is important to help identify and prioritize indicators and evaluation goals. Stakeholders also contribute to considering trade-offs, identifying sources of information, and supporting ongoing work (monitoring) toward continual improvement.

4.3.5 Transparent communication is a prerequisite for constructive stakeholder engagement. Transparency helps develop trust among parties and is a cornerstone for an evaluation of relative sustainability and the future monitoring and evaluation required for continual improvement.

4.4 *Science-based Indicators*

4.4.1 The assessment of options shall be based on relevant indicators. Separate standards should be cited and employed to assure replicable, science-based methods are used to measure each indicator.

4.4.2 This standard practice encourages the development of new science-based indicators for areas of stakeholder concern that are not yet adequately defined in standards.

4.4.3 See Appendix X1 for examples of science-based, measurable indicators.

4.5 *Comparison of Options*

4.5.1 Comparing the relative sustainability of options typically involves the interpretation of data related to past events and conditions (historical baseline) as well as goals and expectations about the future that are inherent when documenting and comparing the effects of a proposed option to the effects of an alternative or "business as usual" option.

4.6 *More Sustainable Outcomes*

4.6.1 An evaluation of relative sustainability is limited to identifying what appears to be a better way of achieving specified goals within a defined context and based on selected indicators. More sustainable outcomes necessarily consider the value of conserving non-renewable resources for future generations (**1**). The ability to compare options and guide decisions to support more sustainable outcomes is compromised if the assessment of one or more options relies on generalized data that do not capture the priorities and trade-offs involved in the specified context.

4.6.2 An evaluation of relative sustainability involves engaging stakeholders to identify priorities and build consensus around what being "more sustainable" means within the specified context.

4.7 *Continual Improvement*

4.7.1 This standard practice requires users to describe the mechanisms that will be applied to advance continual improvement. Because data about the past are limited and knowledge of the future is still more uncertain, indicators should be selected and monitored in a manner that supports timely corrective actions.

4.7.2 The evaluation process and selected indicators should be reviewed and updated when new information and technological options offer opportunities to improve monitoring and analysis.

5. Summary of Practice

5.1 *Basic Principles for Evaluating the Relative Sustainability of Options*—Evaluating relative sustainability involves comparing assessments of two or more options involving a product, process, or project. Each option shall be assessed using the following principles. One option could be the current conditions or status quo as a reference case.

5.1.1 Several basic principles improve the value of assessment outcomes for each option and thus the evaluation of the relative sustainability of the options.

5.1.2 *Transparency*—It is essential that the assessment of each option be documented in a way that allows for reproduction, with clearly communicated procedures and results.

5.1.2.1 The expectation of transparency does not stipulate that all information is made public. There may be situations where information could be considered proprietary or confidential under standard business practices. Confidential business information is not included under the transparency principle.

5.1.3 *Stakeholder Engagement*—The evaluation and associated assessments shall identify and engage stakeholders who are relevant to the evaluation scope and context.

5.1.4 *Timely Communication*—A system should be in place to share information on the status of priority indicators for options being assessed. Untimely reporting or delayed communication with stakeholders can hamper the effectiveness and value of the evaluation and increase the cost of corrective actions.

5.1.5 *Equivalent Treatment*—All assessments shall be developed and conducted using consistent approaches to examine effects relevant to the stated goals and in a manner that is replicable and facilitates objective comparisons.

5.2 *Six Steps for Assessing Sustainability Aspects of Each Option*—The following six steps shall be used to plan and conduct an assessment of each option. Fig. 1 provides a diagram of the evaluation plan.

5.2.1 *Step 1: Define the Evaluation Plan*

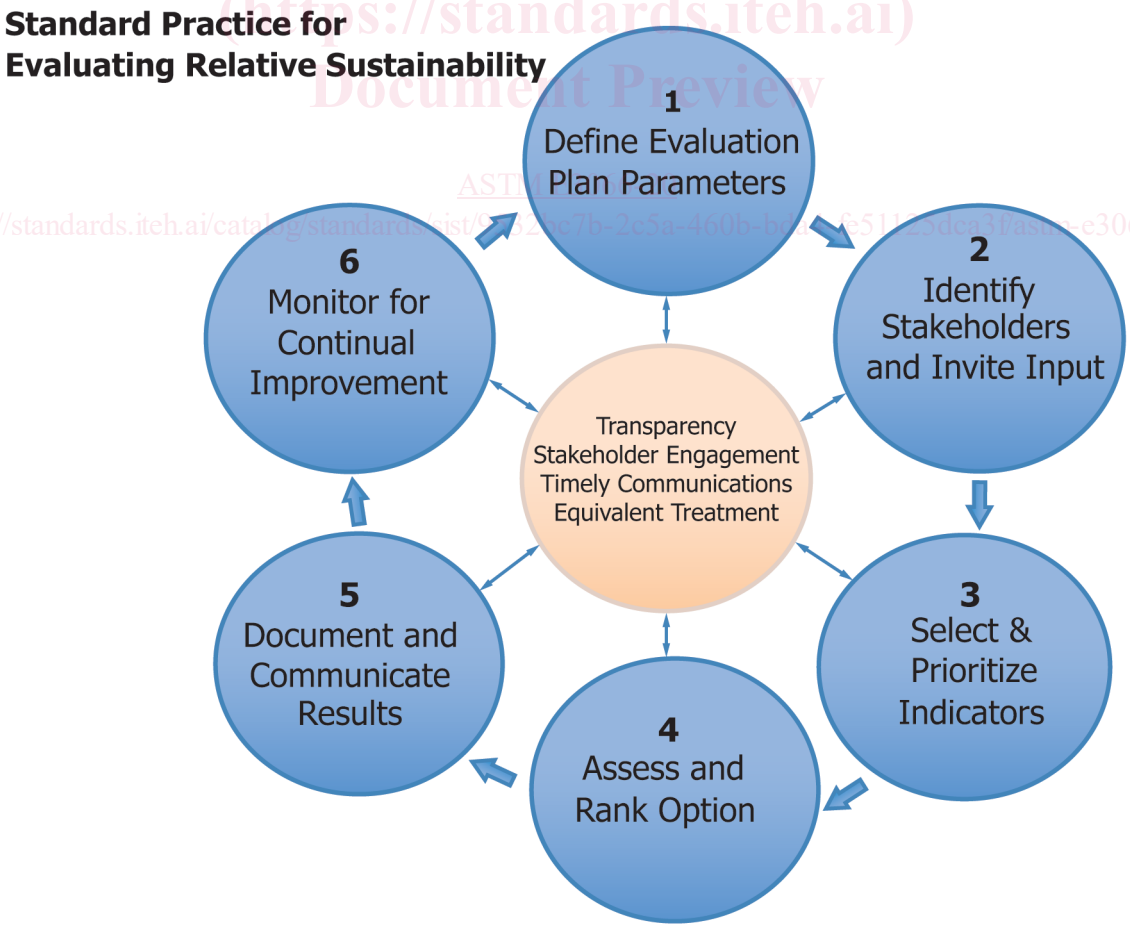

FIG. 1 Representation of Process for Evaluating Relative Sustainability