Quantifying the Challenges of Adopting Sustainability Criteria for Biofuel Production

IISD REPORT

IISD
International Institute for Sustainable Development

SSI
State of Sustainability Initiatives

Damiana Serafini

March 2016

Published by the International Institute for Sustainable Development.

International Institute for Sustainable Development

The International Institute for Sustainable Development (IISD) is one of the world's leading centres of research and innovation. The Institute provides practical solutions to the growing challenges and opportunities of integrating environmental and social priorities with economic development. We report on international negotiations and share knowledge gained through collaborative projects, resulting in more rigorous research, stronger global networks, and better engagement among researchers, citizens, businesses and policy-makers.

IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Government of Canada, provided through the International Development Research Centre (IDRC) and from the Province of Manitoba. The Institute receives project funding from numerous governments inside and outside Canada, United Nations agencies, foundations, the private sector, and individuals.

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Fax: +1 (204) 958-7710
Website: www.iisd.org
Twitter: @IISD_news

Quantifying the Challenges of Adopting Sustainability Criteria for Biofuel Production

March 2016

Written by Damiana Serafini, IISD

Acknowledgements

The author would like to extend her sincere appreciation to Thomas Roetger and Robert Boyd from International Air Transport Association (IATA), for their guidance, valuable insights and inputs.

She would also like to thank Rolf Hogan, Melanie Williams, Elena Schmidt and the entire staff of the Roundtable on Sustainable Biomaterials for their support providing crucial data and contact information to certified operators. Their support added validity and significance to the content of the study.

Much appreciation also goes to the companies and key stakeholders who dedicated valuable time to exchanging data and agreed to be interviewed as part of this research, and the non-governmental organizations, industry associations, standard-setting organizations and government ministries who united stakeholders through their certification schemes and frameworks in an effort to ensure the sustainable development of the biofuel sector.

A message of gratitude is also extended to Vivek Voora and Jason Potts for their valuable input to the study, and to the entire staff at the International Institute for Sustainable Development (IISD) for their editing, administrative and legal support.

This paper was commissioned by IATA.

Executive Summary

In the forerun to the UN Climate Conference in Copenhagen (COP 15) in 2009, the aviation industry committed to the following three main goals to stabilize air transport carbon emissions: improve fleet fuel efficiency by an average of 1.5 per cent per year until 2020; cap net carbon emissions in the industry by 2020; and reduce its net carbon footprint by 50 per cent relative to 2005 levels by 2050 (International Air Transport Association [IATA], 2009). To fulfill these goals, the airlines have been strongly promoting the use of sustainable alternative fuels (SAFs) to improve fuel efficiency and reduce carbon dioxide emissions, in addition to fuel-efficiency improvements.

As the market develops, airlines are pressing the importance of SAFs being certified as sustainable.[1] Producers and stakeholders along the supply chain are therefore in the process of adopting certification schemes for sustainable production practices to supply sufficient volumes of SAF. Depending on their particular circumstances (feedstock, processing technology and location, etc.), producers are faced with different challenges to meet sustainability principles and criteria while going through the process of certification.

Through interviews with producers who underwent certification for sustainable practices, a literature review on sustainability standards and certification processes, and personal communication with professionals from the aviation industry and academia, this study sets out to evaluate the effort needed to achieve sustainability and whether or not a particular principle might limit wider adoption of such certification.

Annex I shows an evaluation of the level of adoption of the most relevant certification schemes and frameworks for implementing sustainable practices in the production of biofuels. The Roundtable on Sustainable Biomaterials (RSB) standard is evaluated in more detail throughout the body of the study as well, as it is considered to be the most comprehensive standard covering the widest and most diverse range of criteria among existing biofuel certification schemes, a characteristic of particular importance to many airlines. With this in mind, the RSB's 12 principles were selected as an appropriate case study. Consequently, interviewees were asked to rank the RSB's principles in order of difficulty of compliance. Four major issues were highlighted:

1. The lack of further flexibility and adaptation of some environmental and social indicators to local conditions may act as a barrier to the process of certification.
2. The failure to guarantee an established sizeable market or deliver a price premium for certified SAFs is limiting wider adoption of sustainability standards.
3. The process of certification for sustainable practices appears simpler for producers who rely on non-agricultural or non-forest wastes for their production processes.
4. Many difficulties in compliance arise from the lack of experience of auditors certifying against a fairly new certification scheme with unique social requirements.

Without further considerations of regional conditions, some indicators can act as limiting factors for wider adoption of sustainability certification schemes. Also, to ensure the availability of sufficient volumes of SAFs certified as sustainable, users need to create a secure demand to help justify the costs of certification. Otherwise, producers may choose to sell their products within other markets that do not require sustainability certification and have high demand, such as agricultural commodity markets.

To ensure the availability of adequate volumes of SAFs for the aviation industry and long-term economic viability, future research should consider supporting the development of SAFs made from non-agricultural or non-forest wastes. Feedstocks like most industrial waste gases and municipal solid waste exhibit particular promise in light of their reduced environmental and social

[1] In the context of this study, certified SAFs are biofuels that have been produced under certified sustainable practices and hold a certificate proving that actors along the supply chain went through the certification process.

impacts, as well as lower operating costs than biofuels manufactured from agricultural and forest resources (including waste biomass).

There are additional gaps not related to the certification process that warrant further consideration in any effort to ensure the regular supply of adequate volumes of certified SAFs to cover the aviation sector's needs. Future research should concentrate on: identifying the challenges presented by the global sourcing of certified SAFs; evaluating customers' appreciation and expectations about sustainable flying and finding a suitable claim that airlines can make on the use of certified SAFs matching those perceptions; and developing an online commercial platform to facilitate trade of certified SAFs to extend their use worldwide.

Table of Contents

1.0 Introduction

1.1 INTRODUCTION

As the aviation industry continues to grow, it has committed to sustainable development. Airlines have taken special interest in biofuels as a means to lower their carbon dioxide emissions and improve fuel efficiency. Nevertheless, the sustainable alternative fuel (SAF) industry is still in its infancy and production volumes remain low when compared to the needs of the global airline sector. The supply challenge exacerbates as users demand the availability of certified SAFs, a process requiring time and capital investment from producers.

This study takes a look at entities that play a role in the biofuel industry and their experiences going through the process of certification under sustainability standards. More precisely, it evaluates potential difficulties of compliance among the various principles of the Roundtable for Sustainable Biomaterials (RSB)—one of the most rigorous and comprehensive standards for biofuels—as a proxy for certification schemes, which might affect the level of adoption and, consequently, the availability of sustainably certified biofuels in global markets.

1.2 OVERVIEW: ICAO RESOLUTION A38-18 ON CLIMATE CHANGE AND AVIATION CLIMATE SOLUTIONS: SUSTAINABLE BIOFUEL

Since 2005, the aviation industry has been convening international gatherings like the Global Sustainable Aviation Summit to set sustainable development goals as far out as 2050. As reported by the International Institute for Sustainable Development (Nelson & Gagnon, 2015), the industry has agreed to pursue the following matters to ensure sustainable growth:

- Noise reduction
- A clear pathway towards carbon-neutral growth to ensure efficient fuel consumption and emission reductions
- The proposed implementation of a global market-based measure (GMBM) for aviation emissions by 2020
- Development of effective and efficient global policies to address the environmental impacts of aviation
- An increase in air-route efficiency
- Sustainable expansion of airports and their surroundings

The availability of improved technologies is key to ensuring that airlines can comply with the above goals. This includes the development of technologies for the production of SAFs.

In 2009, in the forerun to the UN Climate Conference in Copenhagen (COP 15), International Air Transport Association (IATA), Airports Council International, Civil Air Navigation Services Organization, International Business Aviation Council and International Coordinating Council of Aerospace Industries Associations committed to three high-level goals set out to help stabilize air transport carbon emissions growth (IATA, 2009):

- Improve fleet fuel efficiency by 1.5 per cent per year until 2020
- Cap net carbon emissions in the industry from 2020
- Reduce the net carbon footprint of the industry by 50 per cent relative to 2005 levels by 2050

In 2010 the International Civil Aviation Organization (ICAO) adopted the first two goals, further strengthening the fuel efficiency improvement target to 2 per cent per year. To realize these goals, ICAO decided in 2013 in its Resolution A38-18 (IATA, 2009) to develop a GMBM to offset aviation carbon emissions from international aviation. The use of SAFs, "particularly the use of drop-in fuels in the short to mid-term" (ICAO, 2013, p. I-69), with lower greenhouse gas (GHG) emissions than conventional jet fuel, was chosen as a viable option to reduce carbon emissions and the related offsetting obligations under the GMBM. As a result, this option was included in ICAO's Resolution A38-18, defined as a "consolidated statement of continuing ICAO policies and practices related to environmental protection" (ICAO, 2013, p. I-68). ICAO's Committee on

Aviation Environmental Protection subsequently formed the Alternative Fuel Task Force, which is currently working on a methodology to recognize the emissions reduction benefits of SAFs in the determination of aircraft operators' obligations under the GMBM.

Several existing voluntary and regulatory sustainability standards and frameworks are applicable to SAFs, in particular: the RSB standard, the sustainability framework for the production of bioenergy from the Global Bioenergy Partnership (GBEP), the International Organization for Standardization's ISO 13065:2015 (Sustainability frameworks for the production of bioenergy) as well as the regulatory standards in the European Union's Renewable Energy Directive (EU-RED) and the U.S. Renewable Fuel Standard. In the evaluation of these standards and frameworks, special interest by SAF producers and users is being placed on understanding potential difficulties experienced by operators[2] in the certification process, which may convey a limitation on adoption and, consequently, on the availability of sufficient volumes of sustainably certified SAFs in the market. Developing sustainability criteria tailored for SAFs under the GMBM for the aviation sector should build on existing sets of criteria as far as possible.

1.3 OBJECTIVES OF THE STUDY

The level of adoption of a certification scheme depends not only on its legitimacy and performance but also on its ease of applicability. It is essential for the scheme to consider additional costs incurred and the practicality of its requirements in concrete pragmatic situations to allow the participation of audiences in diverse regions of the world.

The aviation sector is particularly interested in sourcing SAFs that have been certified under a robust set of principles and criteria and that leave no room for poor environmental and social practices. Just recently, United Airlines has announced their use of commercial scale volumes of certified SAFs on flights departing from Los Angeles International Airport and has agreed to purchase 15 million gallons of SAFs from AltAir Paramount over a three-year period. AltAir Paramount is currently undergoing the certification process for sustainable practices under the RSB standard (United Airlines, 2016). Considering the airline sector's interest in ensuring that SAFs result in positive environmental and social impacts, the certification process might turn out to be remarkably demanding. The objective of this study is to evaluate the level of effort operators require through the certification process for SAFs under a comprehensive set of principles. More precisely, it estimates the work required to fulfill and follow the principles of a specific standard in an effort to reveal whether a particular principle and corresponding criterion and indicator acts as a challenge for adoption.

On one side, a certification scheme that proves too costly or difficult to comply with might limit the total volume of certified product available in the market. This can dampen the efforts of the aviation industry, which is relying on the use of certified SAFs to reduce GHG emissions. Only a robust certification scheme for SAFs can help the aviation sector achieve emission reductions in a credible and genuine way. On the other side, a certification standard that is too easy to comply with and does not demand much effort in changing the "business-as-usual" scenario can be seen merely as a strategy to improve business reputation rather than a process that ensures sustainable production and operations.

A literature review was undertaken to evaluate the state of adoption of the RSB standard as well as the GBEP, the ISO 13065:2015 and the EU-RED frameworks. Since the RSB standard is considered the most encompassing system certifying "the entire value chain, from farm to end user" (Guariguatta et al., 2011), an in-depth analysis of the standard has been completed via interviews with SAF producers who have become or are in the process of becoming RSB certified.

[2] An operator is an individual, company or other legal entity responsible for the implementation of the principles and criteria of a sustainability certification standard, and applying for participation or participating in a sustainability certification system.

2.0 Methodology

2.1 SECONDARY DATA AND LITERATURE REVIEW

A literature review and several interviews with university and government researchers revealed that there are no published studies available that evaluate the challenges associated with fulfilling the principles from a certification scheme or framework for the sustainable production of biofuels. According to Stefano Ponte, Professor of International Political Economy and Co-director of the Sustainability Platform at Copenhagen Business School, "there is very little empirical evidence assessing certification hurdles in practice" (Stefano Ponte, personal communication, November 13, 2015). Nevertheless, there are a number of publications on related topics that provide some insights.

A study titled *Risky Business: Motivating Uptake and Implementation of Sustainability Standards in the Indonesian Palm Oil Sector* evaluates the factors influencing businesses to join a sustainability standard for the production of palm oil (Gnych, Limburg, & Paoli, 2015). While it does not evaluate the difficulties operators encounter through the certification process to specific principles of a standard, it does show interesting insights on how economic forces such as profit and market price are "the most effective motivator[s] for changing practices" (Gnych, Limburg, & Paoli, 2015). Reputational risk is also a strong motivator for the uptake of certification.

Pilot project reports on the applicability of GBEP's principles and indicators in the field also provide important insights based on the production of biodiesel from soybean oil and ethanol manufactured from sugar cane (Chidiak et al., 2015). The report looks at the ease of applicability and performance of indicators to measure sustainable practices throughout the entire biofuels supply chain. The conclusion points out the indicators that were most problematic for operators to comply with (refer to Annex I for more detailed information) and offers suggestions on modifications needed to make them more applicable at regional levels. It does not consider specifically the different levels of effort by producers to comply with each indicator or a comparison among them.

The need for the regional adaptation of certification schemes is advocated by Jorge Hilbert, who is senior coordinator for the Biomass Program at the Argentine National Institute of Agricultural Technology and an academic researcher. He points out, as an example, that many certification schemes, in particular the EU-RED, require operators to show evidence that the land cultivated for producing biofuel feedstock was under agricultural use before January 1, 2008 (Hilbert & Muñoz, 2012). For agricultural producers in Argentina and many other countries, factual evidence (geo-referencing, satellite imaging, etc.) demonstrating land use is not easily accessible and at times non-existent. This poses a barrier for operators wishing to adopt a certification scheme, as available certified feedstock for biofuel production remains limited.

2.2 ANALYTICAL FRAMEWORK

As previously stated, the objective of this study is to evaluate the level of operational and financial effort operators experience through the certification process for the production and management of SAFs. The answers to this complex question can only be qualitative. A well-suited analytical framework to evaluate qualitative data is sequential data management and interpretation (Ritchie, Lewis, McNaughton Nicholls, & Ormston, 2013). The aim is to order data and facilitate interpretation, involving thematic analysis, typologies and explanatory analysis.

2.3 INTERVIEWS

The data collected for this study are primarily based on data obtained via telephone interviews, complemented by data exchanged through electronic means, with seven operators currently holding valid RSB certificates and one operator with an expired RSB certificate. The sample is too limited to give statistically significant results.

Nevertheless, as the RSB standard covers a wide variety of sustainability aspects and is considered the most comprehensive sustainability standard, comments and explanations of difficulties experienced by operators certifying under this scheme may also be representative of operators certifying under other sustainability schemes that share similar principles, criteria and indicators such as the Round Table on Responsible Soy (RTRS), the Roundtable on Sustainable Palm Oil (RSPO), International Sustainability and Carbon Certification (ISCC), BONSUCRO, ISO 13065:2015 and GBEP.

Additional data was obtained from interviews with professionals at the IATA, the RSB and the certification body SCS Global Services.

Also included were several airlines that have demonstrated an active role in their commitment towards the use of sustainable biofuels in their fleets.

The operators interviewed were chosen based on feedstocks utilized, their track record in SAF conversion and geographical location, so that both developed and developing countries were represented. Also included were operators involved in the transport and delivery of SAFs, and those who experienced significant changes in their administrative process as a result of certification. Participants were identified based on the participating operators list found on the RSB website. Suggestions from RSB staff were also taken into account in the selection process.

Table 1: Characteristics of Operators Interviewed

Operators Certified by RSB				
Group	**Entity**	**Region**	**Product**	**Feedstock**
1	GreenWood Tree Farm Fund, LP	USA	Biomass Producer	Wood chips-hybrid poplar
	Biomass Supplies Pvt Ltd	Asia-Sri Lanka	Biomass Producer	Wood chips-Gliricidia trees
	Sunchem Biofuel Development South Africa	South Africa	Feedstock Producer	Solaris seed tobacco
2	Camelina Company Spain	EU-Spain	Biodiesel and Aviation Kerosene Producer	Camelina
	Shoalhaven Starches Pty Ltd (Manildra Group of Companies)	Oceania-Australia	Ethanol Producer	Waste starch from wheat processing
	Beijing Shougang LanzaTech New Technology Co., Ltd.	Asia-China	Ethanol Producer	CO feed gases via microbial fermentation
3	SkyNRG	EU-Netherlands	Supply Chain & Logistics for Biokerosene/ Jetfuel	Used cooking oil and other feedstocks
4	Dynamic Fuels LLC	North America-USA	Renewable Diesel / Biojet Mix	Wastes, animal by-products, greases and vegetable oils

Interviewed operators were separated into groups according to their similarities in feedstock, product, location and whether or not they held a valid certificate. Table 1 illustrates further details of those operators interviewed.

Interviews were semi-structured, where operators were asked to share their experiences and perceptions of the certification process in general. According to their responses, the conversation went into greater detail on the specific principles, where operators reported having experienced difficulty in compliance, in an effort to better understand the reasons behind the challenges. At the conclusion of the interview, operators were asked to report any unforeseen benefits experienced due to certification.

After the interview, operators were presented with a document asking them to rank the level of difficulty and effort dedicated to achieving compliance with each principle of the RSB

standard according to the following predefined parameters:

- *Simple*: a principle for which an operator had to perform no actions or minimal actions to fulfill compliance.
- *Challenging*: a principle for which an operator had to implement modifications to their operations to achieve compliance.
- *Difficult*: a principle for which and operator had to modify its operations and experience a significant capital investment in order to accomplish compliance.

Interviews were transcribed directly from telephone conversations and rankings were obtained by email.

2.4 BACKGROUND: ROUND TABLE ON SUSTAINABLE BIOMATERIALS: PRINCIPLES AND CRITERIA

Among the existing sustainability standards, the RSB standard covers the widest scope of environmental, social and economic sustainability criteria. Its list of principles and criteria is therefore suitable as a comprehensive directory covering almost all relevant topics.

The following principles were evaluated in detail and compared with each other to estimate the level of difficulty they present to operators currently holding a valid certificate during the certification process (RSB, 2011):

Principle 1: Legality

- Biofuel operations shall follow all applicable laws and regulations.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 2: Planning, Monitoring and Continuous Improvement

- Sustainable biofuel operations shall be planned, implemented and continuously improved through an open, transparent and consultative impact assessment and management process and an economic viability analysis.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 3: Greenhouse Gas Emissions

- Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing life-cycle GHG emissions as compared to fossil fuels.
- Operators who must comply: Feedstock Producer, Feedstock Processor, Biofuel Producer and Biofuel Blender.

Principle 4: Human and Labour Rights

- Biofuel operations shall not violate human rights or labour rights, and shall promote decent work and the well-being of workers.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 5: Rural and Social Development

- In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 6: Local Food Security

- Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 7: Conservation

- Biofuel operations shall avoid negative impacts on biodiversity, ecosystems and conservation values.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 8: Soil

- Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.
- Operators who must comply: Feedstock Producer.

Principle 9: Water

- Biofuel operations shall maintain or enhance the quality and quantity of surface water and groundwater resources, and respect prior formal or customary water rights.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 10: Air

- Air pollution from biofuel operations shall be minimized along the supply chain.
- Operators who must comply: Feedstock Processor and Biofuel Producer.

Principle 11: Use of Technology, Inputs and Management of Waste

- The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.
- Operators who must comply: Feedstock Producer, Feedstock Processor and Biofuel Producer.

Principle 12: Land Rights

- Biofuel operations shall respect land rights and land-use rights.
- Operators who must comply: Feedstock Producer and Feedstock Processor.

3.0 Results and Evaluation

Results from the investigation are presented and analyzed in four different sections. Section 1 presents the raw data from the ranking surveys obtained from operators. Section 2 offers a comparison and evaluation of the operators' answers to each principle, exposing differences and similarities reported from experiences encountered during the RSB certification process. Section 3 exposes the case of an operator who deliberately decided not to renew their RSB certificate and looks into the reasons why they opted out of the system. Section 4 illustrates unforeseen benefits certified operators reported experiencing as a result of going through the RSB certification process.

Three recurring themes emerge from the data obtained:

1. Operators who base their production processes on non-agricultural or non-forest inputs (including both wastes and raw materials) have a much easier time complying with indicators than those who rely on agricultural or forest feedstocks.
2. Participants operating in developing countries experienced more difficulty finding available data than those located in developed countries.
3. There is a need for further adaptation of indicators to local conditions and specific feedstocks.

Concluding arguments 1 and 2 are not solely related to the RSB certification scheme but common to all sustainability certification schemes for SAFs. Therefore, even though the sample size is limited to statistically generalize specific findings, we suspect that most operators in the SAF supply chain aspiring to become certified for sustainable practices will encounter these major difficulties.

3.1 QUALITATIVE ANALYSIS OF DATA COLLECTED

Throughout the data gathering, evaluation and research processes, several factors were identified that presented a challenge for operators during the certification process. According to their specific circumstances (operating processes, feedstock, location, etc.), some operators reported experiencing higher efforts than others when meeting a particular principle.

The following sections will discuss the differences and similarities experienced by the members within each group.

3.1.1 Section 1: Principle Rankings

Operators in Groups 1, 2 and 3 were asked to rank the 12 principles from the RSB standard according to difficulty of compliance. Figure 1 shows the overall ranking results.

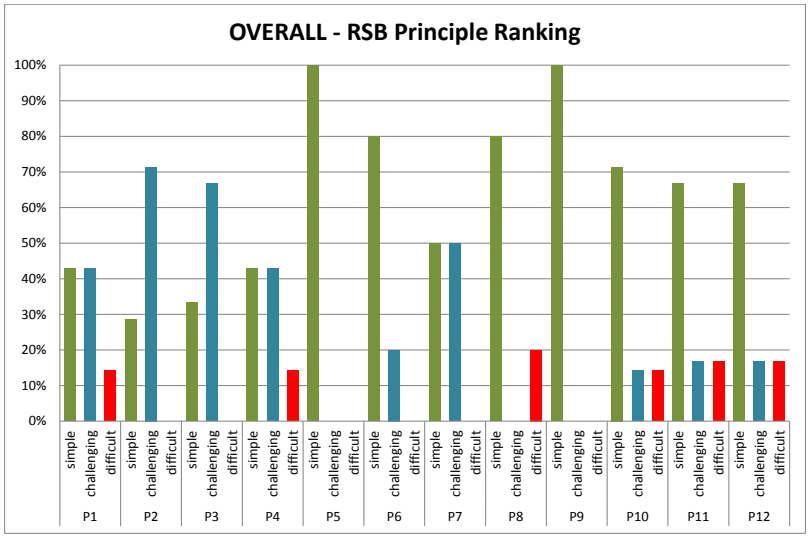


Figure 1: Overall Ranking of RSB Principles According to Difficulty of Compliance

3.1.2 Section 2: Comparison of Ranking Among Groups

The responses of Groups 1 and 2 were analyzed principle by principle in an effort to find differences and similarities among the experiences reported by feedstock and biofuel producers respectively, in compliance with the RSB's standard.

Following is the ranking of each principle conveyed by operators, and a general analysis of their most noteworthy comments. As illustrated in Table 1 above, the sample size for this section is a total of six operators from Groups 1 and 2.

Table 2: Principle 1: Legality

Principle Description	Ranking	Percentage
Biofuel operations shall follow all applicable laws and regulations.	Simple	33%
	Challenging	50%
	Difficult	17%

Feedstock and biofuel producers who obtain their feedstock from agricultural or forest sources ranked Principle 1 as challenging and difficult to comply with through the certification process. In all cases, they faced difficulty in procuring adequate and timely information from farmers employing migrant workers or operating in regions of the world where farming contracts are often established through verbal agreements. These operators are situated in developing countries where laws are not always strictly enforced and people tend to use their own procedures for establishing working contracts.

The operator describing compliance with Principle 2 as challenging was a biofuel producer who attributed their difficulty to the operations of feedstock suppliers as opposed to their own refining operations. Their feedstock is an annual crop and suppliers change constantly. As a result, the operator needs to go over the certification process with new suppliers every year, and even if farmers follow applicable laws and regulations, getting legal documentation from them was time consuming and required a significant investment in training personnel. Operators who use annual crops as feedstock as opposed to operators who base their production on perennial crops or wastes are disadvantaged concerning the amount of legal information they need to gather to comply with the legal criteria. Most biofuel producers who are tied down to a single feedstock conversion technology using an annual crop as the main input are bound to encounter these types of problems.

Operators ranking the principle as simple to comply with were a feedstock and a biofuel producer. The feedstock producer operates in a developed country where laws are strictly enforced, compliance is regularly monitored and nonconformity is usually reprimanded, which makes it easier to comply with all requirements of Principle 1. The biofuel producer bases its operations on waste gases from a steel mill, a highly regulated industry mainly due to its global exposure. Therefore, they find themselves already in compliance with indicators required under Principle 1 in order to operate.

Table 3: Principle 2: Planning, Monitoring and Continuous Improvement

Principle Description	Ranking	Percentage
Sustainable biofuel operations shall be planned, implemented and continuously improved through an open, transparent and consultative impact assessment and management process and an economic viability analysis.	Simple	33%
	Challenging	67%
	Difficult	0%

All feedstock producers found it simple to comply with Principle 2 except for one. The exception was an emerging business with a new crop currently undergoing pilot testing. They were still adapting to operating in a new country and had not been in business long enough to prove continuous improvement in their operations.

In contrast, all biofuel producers reported Principle 2 as a challenging principle to comply with through the certification process. They all agreed that developing, implementing and maintaining an updated Environmental

and Social Management Plan was very time consuming. Also, one operator pointed out that the consultation process under the RSB standard was more demanding than required by national law.

Table 4: Principle 3: Greenhouse Gas Emissions

Principle Description	Ranking	Percentage
Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing life-cycle GHG emissions as compared to fossil fuels.	Simple	20%
	Challenging	80%
	Difficult	0%

All operators except for one agreed that it was challenging to comply with Principle 3. At the feedstock production level, the challenges experienced were attributed mainly to the fact that they managed newly developed crops for which GHG emissions data were not readily available. They had to dedicate significant time and personnel to finding relevant information. Difficulties experienced were not a result of the standard itself or this particular principle but instead a consequence of business maturity.

Biofuel producers ranked this principle as challenging to comply with, primarily due to the work required in obtaining data from agricultural feedstock suppliers. In one case, the region where the operator is located did not require any GHG emissions accounting. The significant amount of data they had to compile on a subject in which they lacked previous experience made the process cumbersome.

It is worth mentioning that the operator who ranked Principle 3 as simple to comply with was a biofuel producer who is also a technology developer. The process of approval for the use of new technologies includes the accounting of GHG gasses to determine the overall environmental footprint of the new development. Therefore, to comply with Principle 3, this operator only had to retrieve previously recorded data and enter it into the RSB GHG calculation tool.

Table 5: Principle 5: Human and Labour Rights

Principle Description	Ranking	Percentage
Biofuel operations shall not violate human rights or labour rights, and shall promote decent work and the well-being of workers.	Simple	33%
	Challenging	50%
	Difficult	17%

The ranking among feedstock producers was evenly distributed: the same number of operators who ranked Principle 4 as simple to comply with also ranked it as challenging and difficult.

The feedstock producer ranking it as difficult attributed it to the auditor's lack of experience in the region rather than the demands of the principle. They believed the auditor was wrongfully benchmarking processes to other operators in the region, therefore assuming non-compliances common to practices in the developing country where it conducted its business.

All operators who ranked the principle as challenging to comply with were located in developed countries. The challenge for these operators was not in complying with indicators, but with having adequate written documentation to prove compliance.

Surprisingly, the operator reporting their effort as simple conducts their business in a developing country with a questionable record in human and labour rights business practices. The discrepancy might be attributed to the fact that the project is being run by a consortium of big and mature entities headquartered in developed countries that follow just working practices regardless of where they locate their businesses.

Table 6: Principle 5: Rural and Social Development

Principle Description	Ranking	Percentage
In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.	Simple	100%
	Challenging	0%
	Difficult	0%

There was unanimity on the ranking where all members reported Principle 5 as simple to comply with through the certification process. This could be attributed to the fact that operators applying for RSB certification share a positive intent towards social development.

Table 7: Principle 6: Local Food Security

Principle Description	Ranking	Percentage
Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.	Simple	80%
	Challenging	20%
	Difficult	0%

While for most operators it was simple to comply with Principle 6, a feedstock producer reported experiencing some challenges. They reported having to spend significant time interpreting the meaning of the principle and arriving at a common definition with RSB staff. They also found it challenging to find the data necessary to prove that their operations did not put their own workers on the company's payroll, at risk of lacking adequate food supplies. This may not be uncommon in developing countries where food security is not always covered by local laws, and therefore there are no units of measurement to prove the degree of food security among the population.

Table 8: Principle 7: Conservation

Principle Description	Ranking	Percentage
Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values.	Simple	50%
	Challenging	50%
	Difficult	0%

Most feedstock producers agreed that complying with Principle 7 was simple. Nevertheless, a member ranked it as challenging, arguing that the concept of biodiversity was understood differently across various regions and, as a result, compliance with the principle's requirements was left to the auditor's interpretation, which in this case did not coincide with the company's concept.

In contrast, most biofuel producers using agricultural products as their feedstock reported facing challenges complying with Principle 7. They attributed their challenges mainly to the substantial effort required to gather data from their suppliers operating on large agricultural sites, not all of whom had information on land use prior to the 2008[3] cut off date.

The overall results obtained may be attributed to business size. Feedstock producers interviewed are either managing a relatively small forest plantation or small plots of lands where they are still at the pilot level of their business venture. Conversely, participating biofuel producers source their agricultural feedstocks from large farming producers or co-ops and have to manage data from several farming sites.

The operators using non-agricultural or non-forest waste did not encounter challenges complying with Principle 7, as their feedstock is not derived from the land.

Table 9: Principle 8: Soil

Principle Description	Ranking	Percentage
Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.	Simple	80%
	Challenging	0%
	Difficult	20%

While most members had no trouble complying with Principle 8, one feedstock producer ranked it as difficult because they had to pay for services rendered by a third party to obtain and analyze soil samples. They also argued that the standard considered soil health from a natural system

[3] January 1, 2008 was the last day that land could be converted from other uses to agricultural use. If conversion took place beyond that date, the operator is denied certification.

perspective rather than an agricultural one, which does not align with their business model.

Table 10: Principle 9: Water

Principle Description	Ranking	Percentage
Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.	Simple	100%
	Challenging	0%
	Difficult	0%

There was broad agreement among all group members ranking Principle 9 as simple to comply with through the certification process. It is worth noting that none of the participants operated in a water-deprived region, and the overall sample size was too small to attribute results to the entire industry.

Table 11: Principle 10: Air

Principle Description	Ranking	Percentage
Air pollution from biofuel operations shall be minimized along the supply chain.	Simple	67%
	Challenging	17%
	Difficult	17%

All biofuel producers ranked compliance with Principle 10 as simple. The same cannot be said among feedstock producers who evenly distributed Principle 10 among its ranking parameters.

The feedstock producer facing challenges cited that the RSB air quality requirements are more stringent than those demanded by local laws, and therefore it was not easy to persuade their contractors to adjust accordingly. The operator who found it difficult to comply with Principle 10 cited having to include stakeholders previously not consulted—such as residents and businesses from nearby towns—and biodiversity, as the main difficulty.

Table 12: Principle 11: Use of Technology, Inputs and Management of Waste

Principle Description	Ranking	Percentage
The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.	Simple	60%
	Challenging	20%
	Difficult	20%

There were differing views in the level of difficulty among group members. Most ranked Principle 11 as simple except for two operators, who ranked it challenging and difficult. At the feedstock production level, the challenge was not in waste management but in the use of chemicals. The RSB standard requires the use of specific herbicides and pesticides that are not always available for purchasing in local markets. Adopting their use to comply with Principle 1 meant an added production cost.

At the biofuel production level, the operator utilizing microbial wastes as their input expressed facing some challenges when complying with Principle 11. They projected that compliance would result in a significant capital investment on the purchase of waste water treatment technology for large-scale operations, a process not currently being used at their pilot production facility.

Table 13: Principle 12: Land Rights

Principle Description	Ranking	Percentage
Biofuel operations shall respect land rights and land use rights.	Simple	67%
	Challenging	17%
	Difficult	17%

Most members ranked Principle 12 as simple to comply with, with two exceptions. A feedstock producer reported experiencing a few challenges because, in the developing country where they operate, land cannot be sold and is only transferred within immediate family members. They were able to resolve the barrier using a local adaptation measure to account for regional regulations on land rights.

The operator who ranked the principle as difficult to comply with was a biofuel producer sourcing their inputs from an annual crop. They described having to invest a significant amount of time (added labour costs) mapping land rights boundaries. When sourcing feedstock from annual crops, the rotation among suppliers is usually high. For biofuel producers, this means that they need to map land rights boundaries from different suppliers constantly.

Group 3

Group 3 includes a single member, as it does not have a matching partner currently holding a valid RSB certificate. This operator is of great interest to the results of the study as they involve the process of certification throughout the supply chain and logistics for SAFs, a crucial player in the supply chain to ensure sustainable transport and delivery of the biofuel.

The principles that apply to this operator are Principles 1–4, 10 and 11. Table 14 shows their ranking results.

The operator expressed real satisfaction with the certification process and reported facing challenges in compliance with only one principle. They argued that most of the criteria encompassed in Principle 2 did not apply to their operations, and suggested that the principle should be adjusted to the specific activities of the different operators (feedstock producer, biofuel producer and blender) to simplify the certification process.

In this case, the certification process for sustainable practices does not represent a limiting factor for participants operating in the supply chain and logistics for SAFs. Nevertheless, this finding is based on a single operator and cannot be generalized.

Table 14: Ranking Results for Group Three

Principle	Ranking
Principle 1: Legality	Simple
Biofuel operations shall follow all applicable laws and regulations.	
Principle 2: Planning, Monitoring and Continuous Improvement	Challenging
Sustainable biofuel operations shall be planned, implemented and continuously improved through an open, transparent and consultative impact assessment and management process and an economic viability analysis.	
Principle 3: Greenhouse Gas Emissions	Simple
Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing life-cycle GHG emissions as compared to fossil fuels.	
Principle 4: Human and Labour Rights	Simple
Biofuel operations shall not violate human rights or labour rights, and shall promote decent work and the well-being of workers.	
Principle 10: Air	Simple
Air pollution from biofuel operations shall be minimized along the supply chain.	
Principle 11: Use of Technology, Inputs and Management of Waste	Simple
The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.	

3.1.3 Section 3: Expired Certificate

The operator in Group 4 holds an expired certificate from the RSB. The interview focused on the reasons why they did not renew the certificate and if it relates to difficulties experienced during certification.

It should be noted that the operator who was interviewed for this study was not the one who underwent the certification process for sustainable practices. This operator had purchased the company while it held an unexpired RSB certificate. During the interview, the new owner explained that they chose not

renew the certificate because, even though they managed to sell uncertified SAFs to the aviation sector, they were unable to sell certified SAFs after several years from the date of certification. They argued that multiple factors contributed to the failure to sell any product even though there was an existing market present. In addition, the new owners chose to focus on markets where certification is not requested by consumers.

3.1.4 Section 4: Additional Benefits

Groups 1–3 were asked to report benefits resulting from the actions taken or modifications applied to their operations to comply with each principle. Their responses show that all operators except for one experienced significant improvements in the organization and management of administrative data as a result of the certification process.

Several operators also reported that, while holding an RSB certificate did not generate a premium for their product, it helped improve their image and attract new investors.

Despite these benefits, most operators agreed that certification costs (monetary and time requirements) were too demanding for a product that did not have a secure and large enough market (not necessarily commanding a price premium).[4] This observation was made with respect to most sustainability certification schemes. Without a stable market demanding significant volumes of sustainably certified products, there is no real incentive to invest in certification. Operators concluded that they would either not renew their certificate or renew it, limiting their scope.

Most, if not all, airlines would not run the reputational risk of using SAFs without proven sustainability credentials. Therefore, unless a clear message is sent to producers that the aviation sector represents a secure market via large-scale purchasing commitments, the volume of certified SAFs will likely remain limited.

[4] As reported by participating biofuel producers, in order to offer SAFs that are price competitive with conventional jet fuel, producers need a large-scale market in order to take advantage of economies of scale and avoid having to rely on a price premium.

4.0 Conclusions

4.1 KEY FINDINGS

This study illustrates the effort operators expend in the certification process for the production of certified SAFs. As the airline industry progresses and consolidates its commitment to sustainable growth, the market for sustainably certified SAFs will grow. A new wave of operators will be looking at certifying their processes to meet the demand and create a well-functioning emerging market. It is therefore important to understand the practicality and applicability of a credible certification scheme that can ensure sustainable practices and that can be easily adopted without compromising its integrity.

Interviews with certified operators and the data gathered have resulted in some key findings that can assist with better understanding the process of certification and the effect it has on the volumes of sustainably certified biofuels available in the market:

1) The lack of further flexibility and adaptation of some environmental and social indicators to local conditions may act as a barrier to the process of certification.
2) The failure to provide an established and sizeable market or deliver a price premium for certified SAFs is limiting the wider adoption of sustainability standards in biofuel supply chains.
3) The certification process for sustainable practices appears simpler for biofuel producers who rely on non-agricultural or non-forest wastes for their production processes.
4) Compliance difficulties arise from the lack of auditor experience certifying against a new certification scheme with unique social requirements.

Tackling all these gaps can help motivate participation in the certification process for SAFs.

4.2 CONCLUDING MESSAGES

The results from this study indicate that the certification process for sustainable production of biofuels can act as a limiting factor for the wider adoption of sustainability standards. Further adaptation of principles and criteria to local conditions can potentially allow more producers to partake in markets for certified SAFs.

In addition, users who demand certified SAFs need to establish a reliable market and perhaps be willing to pay a price premium, so that producers have clear motivation to certify their products and are able to justify additional costs.

Furthermore, as the production of SAFs from non-agricultural or non-forest wastes (exhaust industrial gases, municipal solid waste, etc.) becomes more streamlined and demand increases, the adoption of sustainability criteria will likely increase, as the certification process has proven to be simpler and not a limiting factor for such producers.

Encouragingly, all key challenges to certification found in this study can be overcome. Nevertheless, further cooperation is needed among all stakeholders so that risks are minimized, and an infant industry can experience healthy growth while helping move the aviation sector towards sustainable development.

5.0 Additional Suggestions

5.1 FURTHER RESEARCH AND KEY RECOMMENDATIONS

The findings in this report provide additional information to guide the development of the aviation industry towards sustainable growth organized within the following three premises: regionality, market security and non-agricultural or non-forest waste derived SAFs.

5.1.1 Regionality

Further research: additional regional adaptation of indicators from sustainability certification to local conditions. The challenge is to turn a global standard into a locally adapted scheme that remains global in its essence.

Key recommendation: The formation of local consortia or associations where governments, farmers, biofuel producers, non-governmental organizations (NGOs) and airlines work closely with standard-setting entities to find an adequate definition for the concept of sustainable practices within local limitations for the certification of SAFs. With a better understanding of regional conditions, this collaborative effort can work towards adapting principles and criteria according to a "regional certification scheme," allowing operators to progress towards achieving a global certificate through continuous improvement. This can increase the level of adoption of sustainability criteria, and help reassure the aviation industry of the availability of certified SAFs in the market.

5.1.2 Market Security

Further research: the evaluation of the most effective and efficient market structure that can ensure a credible, long-term market for the commercialization of certified SAFs.

Key recommendation: Operators need a clear signal from future buyers to make investment decisions for scaling up their production and assuming the added costs of the certification process for sustainable practices. Structuring this market adequately will be the key to its success. Considering today's low-carbon prices, the proposed GMBM may still require further support mechanisms and policies to develop the market. Can the SAF market be modelled around the structure of the existing market for conventional jet fuel, or will it be necessary for policy-makers to set specific thresholds to drive the market? These are important matters among a larger set of questions that need to be examined through a comprehensive research study.

5.1.3 Non-Agricultural and Non-Forest Waste Derived SAFs

Further research: the establishment of the potential supplies of non-agricultural or non-forest waste derived certified SAFs to supply the aviation sector.

Key recommendations: In most cases, SAFs derived from non-agricultural or non-forest waste result in less environmental and social impacts, which explains in part why operators using such feedstocks reported experiencing few difficulties while going through the certification process for sustainable practices. There is also an indication that such producers have a lower cost of production than biofuel producers who use agricultural or forest products as feedstock. Many questions still remain in terms of technology preparedness, availability of sufficient volumes of feedstock, American Society of Testing and Materials (ASTM) pathway approval, etc. With this in mind and considering that waste can be sourced almost everywhere, the aviation sector can play a defining role in helping this new industry grow at a faster rate by supporting extensive research on this topic.

5.2 FURTHER RESEARCH ON ADDITIONAL GAPS IN THE SUPPLY OF CERTIFIED SAFs

To better understand the audience for this study, several interviews were conducted with airlines that have demonstrated genuine commitment to the use of SAFs in their fuel mix. Based on their responses, there are a few other research recommendations worth considering.

5.2.1 Global Sourcing of Certified SAFs

Further research: estimate potential volumes of available certified SAFs in different regions around the world.

Key recommendations: Through a collaborative effort among airlines, governments, researchers, and biofuel and feedstock producers, conduct a study examining and mapping the potential volumes of available certified SAFs globally, prioritizing research on major air travel hubs of the world.

5.2.2 Certified SAF Claim

Further research: travellers' understanding and perspectives on the use of certified SAFs by airlines

Key recommendations: Determine which of the next two claims can best help airlines find a balance between the potential added costs of the use of biofuels and prospective economic gains:

- The airline purchases a certain volume of certified SAF, reducing its total emissions of carbon dioxide to a specific level.
- The airline flies its aircraft with a specific mixture of certified SAF and conventional jet fuel, reducing its carbon dioxide emissions to a certain level.

Although both claims contribute to reducing global carbon dioxide emissions, passengers might be more inclined to pay a premium for a plane ticket or chose a specific airline where they can actually experience flying on an aircraft powered by a mix of conventional and renewable fuel.

5.2.3 Online Commercial Platform to Facilitate the Trade of Certified SAFs

Further research: development of an online platform that will allow for the sale and purchase of certified SAF.

Key recommendation: Help fund existing efforts to develop an online platform that will allow airlines to easily purchase certified SAFs and identify sellers in terms of location, type of inputs, refining process, valid certificates (quality and sustainability), available volumes, pricing, carbon dioxide reduction potential, etc. This platform will act as a trustworthy network facilitating the commerce of certified SAFs as well as help airlines extend the reach of their commitment of sustainable growth to many more regions around the world.

These recommendations were formulated based on the importance the aviation sector is placing on having access to certified SAFs. While certification requirements can limit the production of certified SAFs, the aviation industry can actively motivate producers to adopt sustainable practices. It is in the aviation sector's interest to continue to collaborate with feedstock and biofuel producers, researchers, local governments, NGOs and standard-setting entities to enable wider adoption of sustainability criteria for the production of SAFs for the future.

To conclude, the following studies could be undertaken to examine in detail the SAF supply and demand challenge for the aviation industry and its sustainable development implications:

1) The state of SAF production for the aviation sector – establishes the current SAF supply and demand challenge. More specifically, this study would build on existing research efforts from ICAO's Alternative Fuels Task Force (AFTF) on the assessment for future production of SAFs, incorporating additional enabling and/or impeding conditions such as technological innovations. Due to the rapidly evolving shifting SAF production landscape, this initial study is fundamental to ensure that the major dynamics likely to affect the sector are fully captured. For instance, a recent publication by the United Nations Conference on Trade and Development (2016) describing the state of play for second generation biofuel markets in developing countries would provide additional insights into the potential expansion of biofuel production in the near and long-term futures.

2) The current state of sustainable certification in SAF production – determines the current level of sustainable certification in SAF production and the potential for expansion. Information on sustainability standards operating in the SAF sector is for the most part disjointed (using different metrics and datasets) and would benefit from comprehensive and coherent meta-level reporting. Ascertaining the certified portion of SAF production versus total SAFs production will be insightful to determining how certified SAFs are likely to expand overall and in which regions of the world. These insights could then allow for establishing potential regional trends enabling the aviation industry to have the spatially explicit information necessary to develop an effective certified SAF adoption strategy and potentially target efforts over time to ensure that sufficient supply can be found in key parts of the world. The State of Sustainability Initiatives Review 2014 (Potts et al., 2014) is an example of a market analysis focussed on sustainability standards operating in various commodity sectors that identifies where they are operating and where there is potential for future expansion.
3) Pathways for provisioning certified SAFs for the aviation sector – explores potential pathways for the sector to shift from fossil fuel to SAF consumption. Building on studies 1 and 2, research on potential pathways would draw from existing studies on future scenarios and trends in areas such as transportation, business and technology. KPMG's study of future trends to 2030 (KPMG, 2014) and IATA's 20 Year Passenger Forecast (IATA, 2015) are examples of research that will be insightful for this study. The study would also benefit from a backcasting exercise starting from desired aviation transportation goals to green the industry and establish the various steps, milestones and timelines necessary to achieve the goals. Both the scenarios analysis and backcasting exercise would be the basis for establishing suitable pathways for the aviation sector to adopt more sustainable practices and to strategically overcome the challenges involved in achieving the goals.

The proposed studies would provide the information required for the aviation sector to adopt more sustainable practices and concretely contribute towards achieving the United Nations Sustainable Development Goals (United Nations Sustainable Development Knowledge Platform, 2015).[5]

[5] Specifically, adopting more sustainable practices in the aviation sector will enable Goal 7 – ensure access to affordable, reliable, sustainable, and modern energy for all; Goal 12 – ensure sustainable consumption and production patterns; and Goal 13 – take urgent action to combat climate change and its impacts—undertaken in such as ways to avoid negatively affecting Goal 2 – end hunger, achieve food security and improved nutrition, and promote sustainable agriculture, and Goal 6 – ensure availability and sustainable management of water and sanitation for all.

References

Bonsucro Secretariat (2014, January 15). *Preliminary outcome report 2013 -V1. BONSUCRO*. Retrieved from http://bonsucro.com/site/wp-content/uploads/2013/11/Bonsucro-Preliminary-Outcome-Report-20131.pdf

Chidiak, M., Panichelli, L., Rabinovich, G., Buyatti, A., Filipello, C., Rozenwurcel … Rozemberg, R. (2015). *Estudio Piloto Indicadores GBEP de Sustentabilidad de la Bioenergia En Argentina.*

European Commission. (2016). Sustainability criteria. Retrieved from https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/sustainability-criteria

Denis, E. G. (2015, October 7). Creating the bioenergy boom sustainably with ISO 13065. ISO Communication Services. Retrieved from http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref2009

Guariguata, M.R., Masera, O.R., Johnson, F.X., von Maltitz, G., Bird, N., Tella, P. & Martínez-Bravo, R. (2011). *A review of environmental issues in the context of biofuel sustainability frameworks*. Occasional Paper 69. Bogor, Indonesia: CIFOR. Retrieved from http://www.cifor.org/publications/pdf_files/OccPapers/OP-69.pdf

Gnych, S. M., Limberg, G., & Paoli, G. (2015). *Risky business: Motivating uptake and implementation of sustainability standards in the Indonesian palm oil sector*. Center for International Forestry Research (CIFOR). Retrieved from http://www.cifor.org/publications/pdf_files/OccPapers/OP-139.pdf

High Carbon Stock +. (n.d.). *Sustainable palm oil manifesto*. Retrieved from http://www.carbonstockstudy.com/carbonstockstudy/files/80/8043fc8d-1691-4a89-9e60-c87b8375ad22.pdf

Jenkins, B., Baptista, P., & Porth M. (2015). *Collaborating for change in sugar production: Building blocks for sustainability at scale*. Cambridge, MA: The CSR Initiative at the Harvard Kennedy School and Business Fights Poverty. Retrieved from http://www.sabmiller.com/docs/default-source/default-document-library/building-blocks-for-sustainable-sugar.pdf?sfvrsn=0

Hilbert, J. A. & Muñoz, L. (2012). Biocombustibles: El avance de la certificación de sustentabilidad en la Argentina. *Informes Técnicos Bioenergía 2012, 1* (2). Global Bio-Pact. Instituto Nacional de Tecnología Agrícola (INTA). Retrieved from http://inta.gob.ar/sites/default/files/script-tmp-inta_informe_tecnico_bionergia.pdf

International Air Transport Association (2009, December 8,). Halving emissions by 2050: Aviation brings its targets to Copenhagen. Press Release No: 54. IATA. Retrieved from http://www.iata.org/pressroom/pr/Pages/2009-12-08-01.aspx

International Air Transport Association. (2014). *Air passenger forecasts: Global report*. Geneva, Switzerland: IATA & Tourism Economics. Retrieved from http://www.iata.org/publications/Pages/20-passenger-forecast.aspx

International Civil Aviation Organization. (2013). Assembly Resolutions in Force (as of 4 October 2013). (Published by Authority of the Secretary General.) Retrieved from http://www.icao.int/Meetings/GLADs-2015/Documents/A38-18.pdf

International Sustainability & Carbon Certification. (2015, August 11). ISCC PLUS certified oilseeds are taking off. International Sustainability & Carbon Certification. Retrieved from http://www.iscc-system.org/en/news-press/press-releases/august-11-2015-iscc-plus-certified-oilseeds-are-taking-off/

KPMG. (2014). *Future State 2030: The global megatrends shaping governments*. Retrieved from https://www.google.co.in/search?q=KPMG+Future+Trends&oq=KPMG+Future+Trends&aqs=chrome..69i57j69i60.3700j0j7&sourceid=chrome&es_sm=93&ie=UTF-8

Maps of the World. (2014, November 19). Top 10 soybean producing countries. Retrieved from http://www.mapsofworld.com/world-top-ten/soybean-producing-countries.html

Nelson, G. & Gagnon, S. (2015). *The Global Sustainable Aviation Summit Bulletin*. Winnipeg, MB: International Institute for Sustainable Development. Retrieved from http://www.iisd.ca/download/pdf/sd/enbplus198num2e.pdf

Potts J., Lynch M., Wilkings A., Huppé G.A., Cunningham M., & Voora V. (2014, March). *The State of Sustainability Initiatives Review 2014: Standards and the green economy*. IISD and IIED. Retrieved from http://www.iisd.org/library/state-sustainability-initiatives-review-2014-standards-and-green-economy

Ritchie, J., Lewis, J., McNaughton NIcholls, C. & Ormston, R. (2013). *Qualitative research practice: A guide for social science students and researchers*. SAGE. Retrieved from http://www.sagepub.com/sites/default/files/upm-binaries/58628_Ritchie__Qualitative_Research_Practice.pdf

Round Table on Sustainable Biomaterials. (2011). *Consolidated RSB EU RED Principles & Criteria for Sustainable Biofuel Production*, RSB reference code: [RSB-STD-11-001-01-001 (Version 2.1)]. Retrieved from http://rsb.org/pdfs/standards/RSB-EU-RED-Standards/13-03-01-RSB-STD-11-001-01-001%20vers%202.1%20Consolidated%20RSB%20EU%20RED%20PCs.pdf

Roundtable on Sustainable Palm Oil. (2016). Impacts. Retrieved from http://www.rspo.org/about/impacts

Sustainable Development Knowledge Platform. (2015). Sustainable Development Goals, 2015. Retrieved from https://sustainabledevelopment.un.org/?menu=1300

United Airlines. (2016, March 11). United Airlines makes history with launch of regularly scheduled flights using sustainable biofuel. Retrieved from http://newsroom.united.com/2016-03-11-United-Airlines-Makes-History-with-Launch-of-Regularly-Scheduled-Flights-Using-Sustainable-Biofuel?utm_source=United+AltAir+PR+March+11+2016+Event&utm_campaign=11+March+2016+United+AltAir+News&utm_medium=email

United Nations Sustainable Development Knowledge Platform. (2015). *Sustainable Development Goals, 2015*. Retrieved from https://sustainabledevelopment.un.org/?menu=1300

United Nations Conference on Trade and Development. (2016). *Second generation biofuel markets: State of play, trade and developing country perspectives*. Geneva, Switzerland:, United Nations Publications. Retrieved from http://unctad.org/en/PublicationsLibrary/ditcted2015d8_en.pdf

WWF. (2013, April 18). WWF statement on the Review of the RSPO Principles & Criteria. Retrieved from http://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_statement_revised_rspo_principlescriteria_april_2013.pdf

ADDITIONAL LITERATURE REVIEWED

2BSvs. (n.d.) Home. Retrieved from http://en.2bsvs.org/

Bendell, J. (2004). Barricades and boardrooms: A contemporary history of the corporate accountability movement. Programme Paper TBS-13. Geneva: UNRISD. Retrieved from http://www.unrisd.org/80256B3C005BCCF9/search/504AF359BB33967FC1256EA9003CE20A?OpenDocument

Boeing. (2015, December 16). Port of Seattle partners with Alaska Airlines and Boeing on plan to supply sustainable aviation biofuel at Sea-Tac Airport. Retrieved from http://boeing.mediaroom.com/Port-of-Seattle-Partners-with-Alaska-Airlines-and-Boeing-on-Plan-to-Supply-Sustainable-Aviation-Biofuel-at-Sea-Tac-Airport#assets_117:19873

Chidiak, M. & Rozemberg, R. (2015, October 16). *Experiencia con la Implementación de los Indicadores GBEP en la Argentina. Seminario Sobre Indicadores de Sostenibilidad de la Bioenergía en Argentina*. Retrieved from http://www.ucar.gob.ar/images/publicaciones/INFORME%20FINAL%20ESTUDIO%20UNSAM.pdf

Chidiak, M., Rozemberg, R., Filipello, C., Gutman, V., Rozenwurcel, G. & Affranchino, M. (2012). *Sostenibilidad de biocombustibles e indicadores GBEP: Un análisis de su relevancia y aplicabilidad en Argentina*. Buenos Aires, Argentina: Centro de iDeAS, Universidad Nacional de San Martín (UNSAM). Retrieved from http://www.unsam.edu.ar/escuelas/politica/ideas/pdf/Analisis%20indicadores%20GBEP%20ARG_diciembre%20final.pdf

Dingwerth, K. & Pattberg, P. (2009). World politics and organizational fields: The case of transnational sustainability governance. *European Journal of International Relations 15*(4), 707–743

Elkington, J. (2006). Governance for sustainability. *Corporate Governance: An International Review 14*(6), 522–29.

GreenAir online.com. (2014, May 9). Avianca and Lufthansa team up with US next-gen biofuel companies to support alcohol-to-jet fuel approval. Retrieved from http://www.greenaironline.com/news.php?viewStory=1922

Haufler, V. (2003). New forms of governance: Certification regimes as social regulations of the global market. In Meidinger E, Elliott C and Oesten G, eds. *Social and political dimensions of forest certification* (pp. 237–47). Remagen: Verlag Kessel. Retrieved from http://web2.law.buffalo.edu/faculty/meidinger/823/Haufler.pdf

Office of the Chief Economist Agricultural Marketing Service Farm Service Agency Economic Research Service Foreign Agricultural Service. (2015, November 10). World agricultural supply and demand estimates. Washington, D. C.: United States Department of Agriculture. Retrieved from http://www.usda.gov/oce/commodity/wasde/latest.pdf

Ritchie, J., et al, (2013). The Framework approach to qualitative data analysis. NatCen Learning. Retrieved from https://www.surrey.ac.uk/sociology/research/researchcentres/caqdas/files/Session%201%20Introduction%20to%20Framework.pdf

Roundtable on Sustainable Biomaterials. (n.d.). Consolidated RSB EU RED Glossary of Terms, RSB reference code: RSB-DOC-11-001-10-002. Retrieved from http://rsb.org/sustainability/rsb-sustainability-standards/

Warwick, G, (2015). Alaska to test bio-jet fuel from waste wood. Aviation Daily. Retrieved from http://aviationweek.com/awin-only/alaska-test-bio-jet-fuel-waste-wood

Zezza, A. (2013, March). *Sustainability certification in the biofuel sector: A case study of Brazilian ethanol*. Discussion Paper 2013-03. Cambridge, MA: Belfer Center for Science and International Affairs and Sustainability Science Program, Harvard University. Retrieved from http://belfercenter.ksg.harvard.edu/files/Zezza_Sustainability_Certification_Biofuel_DP_2013_web.pdf

Annex I: Current Level of Adoption of Certification Standards and Frameworks

Current Level of Adoption of Certification Standards and Frameworks

This annex reports on the level of participation of operators in various sustainability standards and frameworks. Each scheme measures their progress with varying units (certificates issued, hectares under certification, tonnes of feedstock produced, etc.), which sometimes makes it difficult to compare the level of adoption of one standard versus another one. Nevertheless, it is worth noting general results to understand their acceptance among operators and recognize which part in the production chain has shown greater commitment towards certifying for sustainable practices. For more detailed information, please refer to Annex II.

1. RSB

The RSB launched its certification scheme in 2011 and, to date, 18 operators hold a valid certificate. Of those 18 operators, 50 per cent are biofuel producers; 33 per cent are operators involved in trading, storage and distribution activities; and 28 per cent are feedstock producers. The remaining 11 per cent are held by biochemical producers.

Most biofuel producers holding RSB certification intend to sell their product on the EU biofuels' market; fewer concentrate on local markets. An operator involved in trade and supply logistics has achieved certification of the entire chain of supply and already claims RSB-certified SAF.

The RSB standard is relatively young and is likely to evolve and mature over time. The loyal support from many of its members, such as IATA, Boeing and SkyNRG, has enabled the RSB to become the standard of choice for the aviation sector. This is an important accomplishment since the aviation industry is expected to experience significant growth in the next 20 years and biofuels remain the most realistic and viable option to achieve significant carbon dioxide emission reductions representing an important growth opportunity for the RSB.

2. Global Bioenergy Partnership

The Global Bioenergy Partnership (GBEP) framework has been in development since 2007. The framework is intended to serve as a tool for governments to develop social and environmental policy applicable to the sustainable production of bioenergy.

The framework is still undergoing pilot testing at the regional level. In October 2015, government research entities from Argentina, Brazil, Colombia and Uruguay conducted pilot projects to measure the applicability of GBEP's indicators to actual contexts. The participants concluded that some of the indicators, especially those for which there are no local benchmarking parameters for comparison, need further adaptation to local conditions. Such is the case of indicators recording water and land use, soil erosion, occupational injuries, infrastructure and flexibility on the use of bioenergy (Jorge Hilbert, Instituto Nacional de Tecnologia Agricola. Buenos Aires, personal communication, November 10, 2015; Suani Cohelo, Grupo de Pesquisa Em Bioenergia, Universidade de Sao Paulo, Instituto de Enegia y Ambiente, personal communication, November 10, 2015).

In addition, Argentina argued that compliance with some of the GBEP environmental and social indicators becomes too costly, as biofuel producers have to absorb the cost of sampling and measuring to collect the required data. It also expressed some discontent about the greenhouse gas (GHG) calculator tool and argued that it should be calibrated to local parameters rather than using default or global data (Chidiak et al., 2015).

The level of adoption of the GBEP framework by governments remains low, as their work continues to develop.

3. ISO 13065:2015

The ISO 13065:2015 framework is the conclusion of many years of work, beginning in 2009 by a group of professionals divided into four subcommittees/working groups under the work program ISO/PC 248. "The new ISO 13065:2015, Sustainability criteria for bioenergy, gives a practical framework for considering environmental, social and economic aspects to facilitate the evaluation and comparability of bioenergy production and products, supply chains and applications" (Denis, 2015).

Since its publication in October 2015, its level of adoption remains low (Hager R., ISO, personal communication, December 13, 2015). According to Elizabeth Gasiorowski Denis, Editor-in-Chief of ISOfocus, the ISO 13065 framework has been developed to help businesses, purchasers, other certification initiatives and standards and government entities describe aspects of sustainability and "identify bioenergy processes and products that meet specific conditions and/or legal requirements" (Denis, 2015). Based on the widespread global recognition of the ISO, the adoption of the ISO 13065 framework will likely be extensive and widely recognized by governments and businesses in the near future.

4. European Union Renewable Energies Directive (EU-RED)

The EU-RED (2009/28/EG) contains rules on the sustainable production of biofuels for the transport sector as the precondition for official support and for recognition under the EU biofuel targets. Such biofuels are to generate a clear and net GHG saving without negative impacts on biodiversity and land use. Through the introduction of sustainability criteria, the EU ensures that biofuels reduce GHG emissions by at least 35 wt%,[6] and from 2017 by as much as 50 wt%, compared to fossil fuels. The share of renewable energy in the transport sector must increase to a minimum 10 per cent in every EU member state by 2020 (Directive 2003/30/EC established a goal of 5.75 per cent in 2010).

Since July 19, 2011, the European Commission (EC) has recognized 19 voluntary sustainability standards approved for adoption by the 27 EU member states. Biofuels that are certified by any of these schemes qualify as sustainable biofuels for fulfilling the EU target of 10 per cent renewable energy in transport by 2020. The following five schemes are those most widely used in the biofuels' sector for certification:

a) RSB EU-RED
b) Round Table on Responsible Soy (RTRS) EU RED
c) Roundtable on Sustainable Palm Oil (RSPO) RED
d) International Sustainability and Carbon Certification (ISCC)
e) BONSUCRO EU

a) RSB EU-RED

The level of adoption of the RSB EU-RED, which includes both the RSB Global and EU RED Standards, has already been described; refer to section 2.4 in the paper.

b) RTRS EU-RED

The RTRS is a sustainability certification scheme for soybean producers. The standard was developed in Switzerland in 2010 by a global multistakeholder group comprised of three main sectors: industry/trade/finance, producers and NGOs. Argentina producers currently hold 79 per cent of RTRS certificates. Argentina is currently one of the top producers of soybeans in the world and was among the top three producers and exporters of biodiesel before 2014.[7] Soybean oil is a widely used feedstock for biodiesel production. The rest of RTRS certificates are held in Brazil, Paraguay, Uruguay, the United States, China and India. All these countries are ranked among the top 10 global soybean producers (Maps of the World, 2014).

[6] wt% is a unit that measures weight percentage where, in this example, for every 100 grams of carbon dioxide emitted there must be 35 grams reduction. Therefore, the total grams of carbon dioxide emitted should be 65 grams.

[7] In 2014, the EU imposed antidumping measures against Argentine biodiesel through WTO ruling, severely limiting the export market.

To date, 75 RTRS certificates have been issued,[8] covering a total of 595,127 hectares (ha) and 1,867,365 metric tonnes of product certified. From the total number of certificate holders, 41 per cent (by tonnes of soybeans produced) have also certified their chain of custody (ChoC) and 24 per cent of those have included their soybean oil in the scope of certification. Most of the soybean oil certified is destined to the EU biodiesel market, where sustainability certification is a requirement for member states to comply with the EU-RED requisite GHG emissions reductions through the use of biofuels (European Commission, 2016).

Nevertheless, the adoption of the RTRS scheme is primarily driven by the food and animal feed industries. Soybean oil makes up only about 18 per cent of the seed content by weight. Most of its content is marketed in other various industries, including the food and animal feed industries. Major industry players, such as Unilever and Arla Foods Ingredients, are incorporating the purchase of certified soybean credits as part of their commitment towards sustainable practices, therefore motivating agricultural producers to achieve sustainability certification. Through the RTRS commercial platform, companies can buy certified soybean credits, allowing them to issue claims on their products and their corporate social responsibility reports accounting for sustainable practices as part of their business (D. Kazimierski, RTRS, personal communication, January 14, 2016). The number of hectares certified under the RTRS scheme is expected to increase as consumers' values and habits shift from conventional food production to more sustainable practices.

c) RSPO RED

The RSPO certification scheme was launched in 2012. To date, 356 operators hold a valid certificate covering a total of 3,386,525 ha, or about 20 per cent of global palm oil production (RSPO, 2016). Most certificates are held by large-scale growers covering 2,960,192 ha and located in major producing countries such as Malaysia and Indonesia.

The level of adoption of the standard is considerable and continues to grow even though the World Wide Fund for Nature (WWF, 2013) issued a bold statement claiming that the standard failed to adequately address GHG emissions and pesticide use in 2013. Similarly to the RTRS, the demand for RSPO palm oil comes primarily from food production as opposed to biofuels. Since palm oil is the most consumed vegetable, pressure from the public has influenced a joint commitment from growers, traders, processors, NGOs, end-users, financial institutions and other industry stakeholders to produce and source palm oil from sustainable sources, therefore leading to wider adoption of sustainability certification schemes such as the RSPO (High Carbon Stock +, n.d.).

d) International Sustainability & Carbon Certification (ISCC)

The ISCC is a multistakeholder initiative governed by an association of about 80 members based in Germany. Since 2010 when it launched, 2,731 operators have obtained valid ISCC certificates. While issued certificates are distributed among a variety of operators, approximately 58 per cent are traders, warehouses and collecting-point entities (for waste/residue material not grown/harvested on farms/plantations), which seems to indicate that most operators certifying under the ISCC operate further along the biofuel supply chain.

However, the recent launching of the ISCC PLUS, a "certification scheme for all types of agricultural and alternative feedstocks and their derived products in the feed, food, bioplastic and chemical markets," has been quite successful, having issued 200 certificates already since 2014, half of them being held by companies operating in the food and animal feed market (International Sustainability & Carbon Certification, 2015). While there is no specific report on the amount of hectares or tonnes of product certified, big players in the animal feed and human food sectors such as ADM and Unilever have certified under the ISCC.

[8] Because the RTRS allows group certification, the actual number of producers certified under the 75 issued certificates is 15.406 soybean producers.

e) BONSUCRO EU

The BONSUCRO EU standard has been developed for the certification of ethanol destined for EU member countries. The standard was launched in 2011 after recognition by the European Commission. Currently, 47 operators hold valid production certificates and 25 valid Chain of Custody (ChoC) certificates.

BONSUCRO is a certification scheme applicable to sugar cane and co-products, including ethanol, for use as transport fuel and in the chemical industry. In fact, 81 per cent of production certificates are held by operators producing sugar cane or sugar cane and ethanol.

The increased demand from the food and beverage industries for sustainably certified sugar cane has been an important factor motivating producers to adopt a certification scheme like BONSUCRO. In addition, sustainable practices have been shown to deliver increased productivity and cost savings in sugar cane production (Jenkins, Baptista, & Porth, 2015). Ethanol producers are motivated to certify for sustainable practices by the demand for certified ethanol for land transport primarily by the EU biofuels' market (Potts et al., 2014). Nevertheless, BONSUCRO (2014) admits that it is still "a young and evolving organization," and the variables defining its level of adoption are still not well defined.

Concluding Message

Within the context of SAFs, the information described above indicates that some agricultural and forest feedstock producers (the most widely used raw material for biofuel production) and biofuel producers are willing to go through the certification process for sustainable practices. Nevertheless, agricultural and forest feedstock producers are mainly motivated by other industries (food and animal feed primarily for agricultural and pulp and paper for forestry) to certify their production, rather than by transport fuel sectors. Furthermore, with the rapid growth of the biochemical industry, competition for sustainable agricultural and forest raw materials for the production of SAFs will remain defiant.

Annex II: Operator's Information and Ranking Tables

GreenWood Tree Farm Fund

Operator's details	
Region	USA
Operator Type	Biomass Producer
Feedstock	Wood Chips-Hybrid Poplar
Interview: relevant information	Their certification process was facilitated by already having the FSC certificate (recognized by RSB). The decision to certify was a corporate strategy rather than an economic tactic as there is no wide market for the certified product and the small market which does exist does not pay a premium for certified product. Nevertheless, their image as a company committed to sustainable production attracted new investors. The high cost of certification does present a challenge.

Additional comments:

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	Our business plan is to follow local, regional & national laws, so this one is met easily.
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	This is already in our business plan. But viability doesn't always mean the same thing to everybody.
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Challenging	The difficulty in this is mainly related to our crop. The models tend not to take into account of crop or management strategy. Also, since we are not a common crop much of the data required to effectively provide inputs to the models are not readily available. As such, this represents an added cost to us specifically to do the science to obtain the required info for the model/calculations.
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Challenging	The standard is a bit stricter with regards to some social rights than the local, regional, national laws and as such can be burdensome to add to our policies and have our contractors respect. In principle this is a good idea, but can prove difficult to implement.
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	Simple	We already do this on some level based on our company policies and the FSC. This can prove challenging depending on your certifier and what they deem as a contribution.
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	Again, in our area this isn't an issue. But as a question of land conversion or why not grow food instead of energy can be a troublesome question/challenge depending on the auditor.
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	Challenging	Our location makes this relatively easy for us to meet. But the concept of biodiversity is varied and often it is taken as a natural biodiversity and not system biodiversity. This really comes down to auditor as well.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Difficult	Anytime soils and analysis come into play you are talking money and interpretation. Often this is looked at from a natural system perspective and not an ag or forestry perspective. We viewed this one as very onerous.

Principle	Ranking	Comment
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	If this wasn't an issue where we are located it would have potentially been difficult.
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Difficult	Hard to tell your contractors that their machines have to meet emissions requirements when legally they do not.
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Challenging	This represents an added cost. Technology is not a cheap addition. The waste management is not a big deal for us. Inputs can be a sticking point too depending on the crop and what the auditor deems to be acceptable. Fertilizers often have different formulations, origins and costs
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	Our situation is fairly simple operating in the USA and on our own land.

Additional Comments:

If we didn't already have FSC certification then many of these answers probably would have gone to difficult or most difficult. Our situation is fairly unique as well, which skews the answers towards less difficult.

One of the biggest challenges is that there is no market for our material at present. And, when the market is there we do not receive a premium for our material being certified. If it wasn't for our corporate commitment to being certified sustainable, then we would not be certified. Market and returns just aren't there.

Finally, the biggest challenge for us from RSB is cost. Many other certification programs are significantly less costly per acre than RSB. The scale is 25-45x as much. Plus, there is a minimum cost associated with RSB certification regardless if your production falls well below it. Lastly, the requirement for recertification at short intervals (3 yrs for us) ups the cost as well. Hard to justify/recoup costs of hiring certifier every other year and paying steep RSB license fees.

Biomass Supplies Pvt Ltd

Operator's details	
Region	Asia-Sri Lanka
Operator Type	Biomass Producer
Feedstock	Wood chips-Gliricidia trees
Interview: relevant information	Communication with the RSB was a challenge as they do not have any experience in Africa. Forced labor was a big issue as it was difficult to demonstrate that there was no forced labor, that they had the right meal provision, that they were receiving a fair price for worked hours. Stakeholder consultation was also a challenge as the area is too vast and those affected, if at all, are located too remotely. BENEFIT: it helped the company become better organized in administrative tasks as well as recognize unkown stakeholders.

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Challenging	As mentioned to you this was new to us and nothing to benchmark with. As far as RSB was concerned this was a new experience to them too.
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	Though we had done these it needed to be done in an organized and structured manner. We have started following that process since.
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	N/A	N/A
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Difficult	We believed the auditor was benchmarking us with their previous audits in African nations and convincing them was a task.
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	Simple	Almost 80% of our farmer families are women and this project offers them the opportunity to earn some additional income.
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Challenging	We had to prove that famers didn't face any food security issues.
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	Simple	Gliricidia is grown as a fence on the farmer land and we are encouraging them to grow 3 rows in their home garden which will help them enhance the quantity of organic fertilizer. In addition they can use the 1st row of their fence for their daily cooking need.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	This tree helps improve the soil.
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	N/A	Gliricidia doesn't need water to survive.
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Challenging	We had to ensure that there was no pollution as a result of our operation. However we had considered direct "**stakeholders**" only but as per RSB it involved indirect stakeholders too. This resulted in us having to ensure that the indirect stakeholders were unaffected.

Principle	Ranking	Comment
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	N/A	N/A
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Challenging	They farmers don't have a deed as such but a document from the government awarding the said land to them. This land cannot be sold for whatever reason but can be transferred within the immediate family.

Sunchem Biofuel Development

Operator's details	
Region	South Africa
Operator Type	Feedstock Producer
Feedstock	Solaris Seed Tobacco
Interview: relevant information	BENEFIT: it helped the company structure a protocol for the use of fertilizers and pesticides. Also, they have modified the way they approach new business ventures where they now take into account sustainability considerations during the first stages of development.

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Challenging	"In South Africa, and particularly in the rural areas, there is a massive influx of migrants from neighbouring countries who come from desperate situations and are desperately in need of work. For reasons relating to the social welfare system, etc, for many farmers seeking workers, it is far easier to hire foreign workers than find local labour, since they are often unwilling to work. We have managed to deal with this problem at our sites and ensured that there are local workers, however, it is a big challenge moving forward since even if the workers are paid and treated correctly, the migrant workers are often without the required permits to be in the country. If there could be a program established which could assist workers obtain the permits they need, it could go a great way to uplifting the many migrant workers
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Challenging	The Solaris energy Tobacco is a new crop in a new country and as such one of the main aims thus far has been to gain understanding and experience local experience with the crop and develop the value chain. As such we don't have a base-line for operations from which to improve. Our goal is to always consider how we may improve and listen to stakeholders where relevant but we are also trying to fully understand the local context. We are also always considering the economic viability but do so with the knowledge that everything stands to improve as we move to a fully commercial application of Solaris – currently with relatively small sites and R&D for processing we still need to develop further to reach economies of scale.
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Challenging	As with above, once our processes are more streamlined we shall have a far greater impact with greenhouse gas emissions. Currently we are reducing emissions compared to fossil fuels, but we stand to improve exponentially as we remove inefficiencies and improve on processing, etc.
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	Effective labour rights laws from a government level are in place with the farmers we have worked with. Particularly farmers who are part of other certifications schemes (like Global Gap) are very aware of the conditions that must be met
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	Simple	
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	Not in a food insecure region currently. Solaris also contributes to food security through large feed component.

Principle	Ranking	Comment
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	Simple	Currently growing in a longstanding agricultural region. Will need to keep in mind as we expand.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	Currently Solaris being grown where there is set water allocations, or dryland farming
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	Thus far we have not encountered any issues with this, however our oil is yet to be refined and that is out of the scope of our audit
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	We are still in R&D with some equipment and processing, but thus far our technologies have been safe for both people and the environment.
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	Perhaps we will need to deal with this more in future, however currently all land we have worked on has had clear ownership, with no land rights issues.

Camelina Company España

Operator's details	
Region	EU-Spain
Operator Type	Biodiesel and aviation kerosene producer
Feedstock	Camelina
Interview: relevant information	The rotation among feedstock producers of an annual crop is much greater than that for a perennial crop. This is not considered under the RSB scheme resulting in much higher costs and effort for certification of biofuels derived from annual crops. The company has to go through the effort of convincing new comers to comply with all principles while producers could easily chose to sell their product to the many other markets out there not demanding such process. Also, in the EU there is no requirement to certify other bioproducts than biofuels which makes the market of biofuels less attractive for producers who have the flexibility to manufacture additional bioproducts. Proving that there is no child labor or slave work in paper is also a challenge. BENEFIT: improvement in the company's overall paperwork.

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Difficult	certification was complicated, because it is has shown to be quite difficult to generate documentation along the value chain (specifically for farmers) in order to show during audits.
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Challenging	developing the ESMP and updating periodically is complicated, because although updating the ESMP can be straightforward, developing such tool is a complicated and very time consuming task. Completing the screening tool was complicated, because the initial Screening tool released by RSB was very complicated and time consuming (especially the Self evaluation process). Indeed, this process (Self Risk assessment) has been very much simplified in later releases.
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Challenging	carrying out calculations in the RSB GHG Tool was complicated, because principle 3 requires actual data along the value chain. This is very challenging especially at 2 stages: gathering farmer data (not always accessible) and at the industrial facilities (confidentiality issues).
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Challenging	certification was complicated, because it is challenging to demonstrate some criteria via documents, which makes the audit quite complicated.
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	Simple	N/A
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	N/A
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	Challenging	Certification was complicated, because it is very challenging to trace all plots of land and demonstrate that they were arable before 2008. This entails a huge effort (since the land used varies annually due to new farmers and the rotation scheme employed) which might not be replicable in all locations.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	Certification was straightforward, because CCE production scheme is based on soil improvement through the introduction of an oilseed crop in barley/fallow production schemes, reducing this way desertification processes.

Principle	Ranking	Comment
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	Certification was straightforward, because as CCE does not consume water along the value chain (agronomic production performed in dryland regions) and water consumption at the facilities is very regulated.
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	Certification was straightforward, because In Europe, as well as in Spain, air pollutant levels are highly regulated. Additionally the most critical aspect along the value chain (open-air burning practices in the fields – camelina straw) has also been regulated at European and Spanish level.
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	Certification was straightforward, because CCE does not employ any type of potentially hazardous technology in the development of its activities along the value chain.
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Difficult	Certification was complicated, because mapping of land rights boundaries can be very challenging and time consuming as farmers/farms vary annually.

Additional Comments:

Sustainability certification is a complex procedure, very time consuming in the case of a rotation production scheme where field/land varies from year to year.

Other bio-products in Europe are currently not requested to have such demanding and costly sustainability schemes and certifications, which is a barrier for the biofuel industry.

Manildra Shoalhaven Starches

Operator's details	
Region	Oceania-Australia
Operator Type	Ethanol Producer
Feedstock	Waste starch from wheat processing
Interview: relevant information	Certification is critical and fundamental but it needs to me more efficient, smarter and achievable. Also, there are a few grey areas in what constitutes a non-compliance which led to the auditor to decide. Because the RSB and auditors are not familiar with the certification process, there is too much room for self-interpretation. We are a highly regulated company with already many certifications in other areas. The RSB should make a greater effort to recognize other certification schemes and government regulations. BENEFIT: better image to the company which helped us gain greater support from the government and investors, a critical aspect for global producers like us.

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Challenging	Difficult to achieve 100% compliance for large complex sites. Grey area in what constitutes a non-compliance. E.g if you have 50 conditions in an EPA licence & do not meet one of the conditions 100% of the time.
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Challenging	For a large projects we are required to do an EIS which is similar to a full ESIA. It would be difficult to meet for a small to medium business. Extensive social consultation required above the minimum required by Australian law.
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Challenging	No GHG reduction requirements for biofuels in Australia; or Lifecycle GHG emissions previously calculated, hence a significant amount of work required to calculate GHG emissions.
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Challenging	Difficult to ensure compliance with labor contracted through third parties.
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	N/A – operation not in a region of poverty.	
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	N/A – operation not in a food insecure region	
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	Challenging	Review against RSB indicators required which takes considerable amount of time. Difficult to meet all objectives for a highly modified industrial site.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	N/A – Not a Feedstock Producer	
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	Water Management plan needed to be developed.
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	Air Management Plan already in place.

Principle	Ranking	Comment
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	There are some issues in providing information to the public for a privately owned company.
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	Not an issue for this site.

Lanzatech

Operator's details	
Region	Asia-China
Operator Type	Ethanol Producer
Feedstock	CO feed gases via microbial fermentation
Interview: relevant information	Long and arduous process to convince RSB that the feedstock was in fact a waste regardless of the fact that it was the result of a manufacturing process utilizing petroleum based fuels for energy generation. Internal tension between RSB Services and RSB Standard added much difficulty to the process. The roles between the certifying body and the RSB were not completely clear making it difficult for the operator to know who decides what in the process of certification. BENEFIT: it created an internal platform to hold conversations about environmental and social matters.

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Challenging	Implementation of an ESMS for a demonstration plant requires effort, but has been implemented correctly and according to the requirements of the RSB
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	We went through the RSB certification for our demonstration plant in China. As this is –logically- a non-fully optimized plant, the GHG calculation has been done with on commercial plant parameters.
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	Simple	N/A as plant built in already existing industrial area.
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	N/A as plant built in already existing industrial area.
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	Simple	N/A as no land impact except on already used industrial area.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	N/A as no land impact except on already used industrial area.
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Difficult	I base this expected ranking on what we will implement in a commercial plant. To implement a 100% waste water treatment system, this will require a capital investment.
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	

SkyNRG

Operator's details	
Region	EU-Netherlands
Operator Type	Supply Chain & Logistics for Biokerosene/Jetfuel
Feedstock	Used cooking oil and other feedstocks
Interview: relevant information	Self-risk assessment would be best if adapted to specific operators. Also, some areas are a bit grey ei: water scarcity. Does this refer to temporary scarcity or long term scarcity? P2 has a very long list of items to comply with (operator manual) which not all companies know how to interpret and therefore need to hire third party assistance. It would be best if requirements are translated to procedures and examples are offered. Auditor was very helpful but did not seem much focused on RSB principles but instead on more generalized concepts. GHG calculator was clear but the software is out of date (password had to be rest every time one went on to use the tool). BENEFIT: helped the company become more organized in administrative paperwork.

Principle	Ranking	Comment
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Challenging	Implementing all procedures in our Operations Manual was a quite intensive task. It was not very clear how to do this (especially regarding management structure and responsibilities), an example manual would have been helpful. Furthermore, the amount of reading for all RSB standards is quite a lot while not everything appeared to be applicable. It would be useful if RSB could make some kind of packages that are applicable to each of the 4 categories (feedstock producer, biofuel producer, etc.) to make it more transparent and convenient.
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	Online RSB GHG tool works okay, but could be made much more user friendly and modern given current internet technologies.
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	Fairly easy demonstrated by the basic principles and procedures in place at our company, especially for the chemical plant certified under us.
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities*	N/A	
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	N/A	
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values*	N/A	Fairly easy demonstrated by the procedures in place to protect the environment, how to handle chemical spills, etc.
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	N/A	
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	N/A	

Principle	Ranking	Comment
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	Same as above, plus government regulations and associated independent audits (already in place) ensures the compliance of the chemical processing plant.
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	Not very applicable to our operations as the market is still very pre-mature. Only a hand full of technologies and processing plants are available today leaving us not many freedom of choice.
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	N/A	

Annex III: Ranking Results[9]

Overall Value

		Green Wood	Biomass Supp.	Sunchem	CCS	Manildra	Lanzatech	SkyNRG	TOTAL	PERCENTAGE
P1	simple	•					•	•	3	43%
	challenging		•	•		•			3	43%
	difficult				•				1	14%
P2	simple	•	•						2	29%
	challenging			•	•	•	•	•	5	71%
	difficult								0	0%
P3	simple						•	•	2	33%
	challenging	•		•	•	•			4	67%
	difficult								0	0%
P4	simple			•			•	•	3	43%
	challenging	•			•	•			3	43%
	difficult		•						1	14%
P5	simple	•	•	•	•		•		5	100%
	challenging								0	0%
	difficult								0	0%
P6	simple	•		•	•		•		4	80%
	challenging		•						1	20%
	difficult								0	0%
P7	simple		•	•			•		3	50%
	challenging	•			•	•			3	50%
	difficult								0	0%
P8	simple		•	•	•		•		4	80%
	challenging								0	0%
	difficult	•							1	20%
P9	simple	•		•	•	•	•		5	100%
	challenging								0	0%
	difficult								0	0%
P10	simple			•	•	•	•	•	5	71%
	challenging		•						1	14%
	difficult	•							1	14%
P11	simple			•	•	•		•	4	67%
	challenging	•							1	17%
	difficult						•		1	17%
P12	simple	•		•		•	•		4	67%
	challenging		•						1	17%
	difficult				•				1	17%

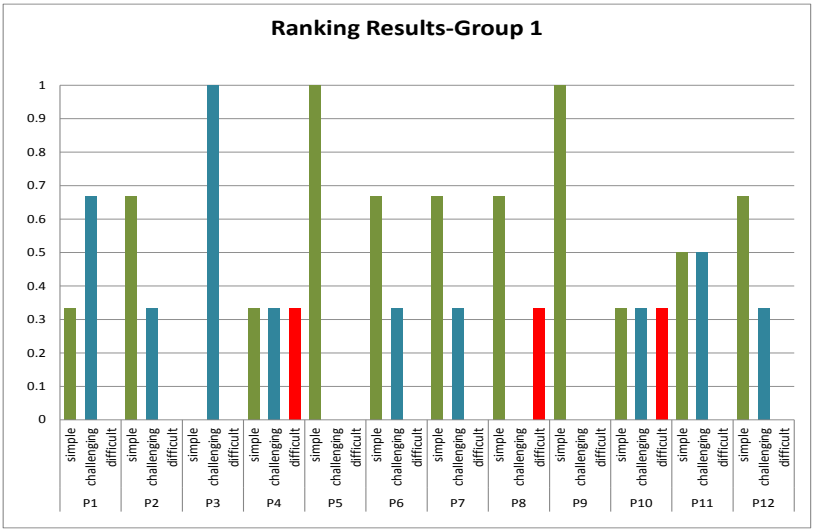
9 The following tables P=Principle

Group 1 and Group 2 Values

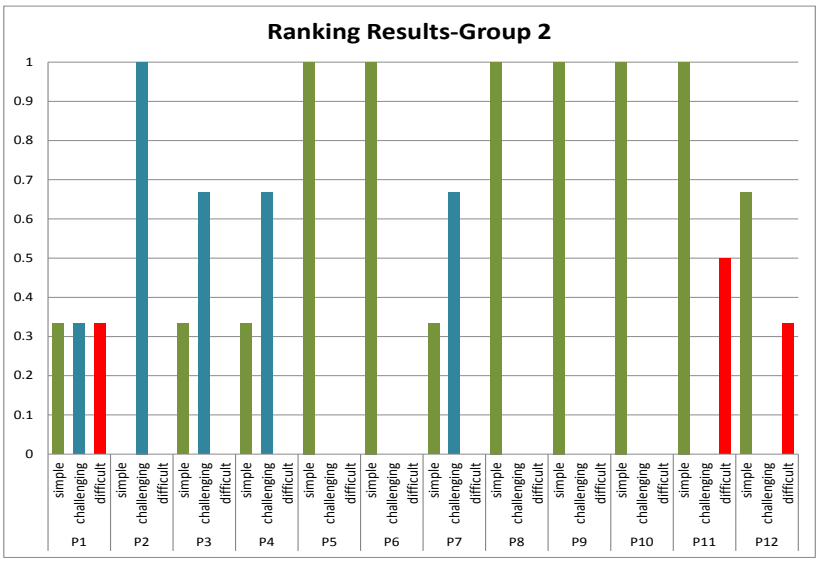
		Green Wood	Biomass Supp.	Sunchem	CCS	Manildra	Lanzatech	TOTAL	PERCENTAGE
P1	simple	•					•	2	33%
	challenging		•	•		•		3	50%
	difficult				•			1	17%
P2	simple	•	•					2	33%
	challenging			•	•	•	•	4	67%
	difficult							0	0%
P3	simple						•	1	20%
	challenging	•		•	•	•		4	80%
	difficult							0	0%
P4	simple			•			•	2	33%
	challenging	•			•	•		3	50%
	difficult		•					1	17%
P5	simple	•	•	•	•		•	5	100%
	challenging							0	0%
	difficult							0	0%
P6	simple	•		•	•		•	4	80%
	challenging		•					1	20%
	difficult							0	0%
P7	simple		•	•			•	3	50%
	challenging	•			•	•		3	50%
	difficult							0	0%
P8	simple		•	•	•		•	4	80%
	challenging							0	0%
	difficult	•						1	20%
P9	simple	•		•	•	•	•	5	100%
	challenging							0	0%
	difficult							0	0%
P10	simple			•	•	•	•	4	67%
	challenging		•					1	17%
	difficult	•						1	17%
P11	simple			•	•	•		3	60%
	challenging	•						1	20%
	difficult						•	1	20%
P12	simple	•		•		•	•	4	67%
	challenging		•					1	17%
	difficult				•			1	17%

Values by Group

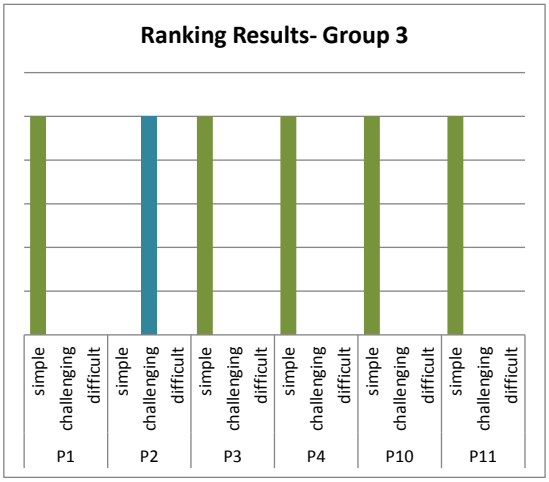
		GROUP 1				
		Green Wood	Biomass Supp.	Sunchem	TOTAL	PERCENTAGE
P1	simple	•			1	33%
	challenging		•	•	2	67%
	difficult				0	0%
P2	simple	•	•		2	67%
	challenging			•	1	33%
	difficult				0	0%
P3	simple				0	0%
	challenging	•		•	2	100%
	difficult				0	0%
P4	simple			•	1	33%
	challenging	•			1	33%
	difficult		•		1	33%
P5	simple	•	•	•	3	100%
	challenging				0	0%
	difficult				0	0%
P6	simple	•		•	2	67%
	challenging		•		1	33%
	difficult				0	0%
P7	simple		•	•	2	67%
	challenging	•			1	33%
	difficult				0	0%
P8	simple		•	•	2	67%
	challenging				0	0%
	difficult	•			1	33%
P9	simple	•		•	2	100%
	challenging				0	0%
	difficult				0	0%
P10	simple			•	1	33%
	challenging		•		1	33%
	difficult	•			1	33%
P11	simple			•	1	50%
	challenging	•			1	50%
	difficult				0	0%
P12	simple	•		•	2	67%
	challenging		•		1	33%
	difficult				0	0%



		GROUP 2				
		CCS	Manildra	Lanzatech	TOTAL	PERCENTAGE
P1	simple			•	1	33%
	challenging		•		1	33%
	difficult	•			1	33%
P2	simple				0	0%
	challenging	•	•	•	3	100%
	difficult				0	0%
P3	simple			•	1	33%
	challenging	•	•		2	67%
	difficult				0	0%
P4	simple			•	1	33%
	challenging	•	•		2	67%
	difficult				0	0%
P5	simple	•		•	2	100%
	challenging				0	0%
	difficult				0	0%
P6	simple	•		•	2	100%
	challenging				0	0%
	difficult				0	0%
P7	simple			•	1	33%
	challenging	•	•		2	67%
	difficult				0	0%
P8	simple	•		•	2	100%
	challenging				0	0%
	difficult				0	0%
P9	simple	•	•	•	3	100%
	challenging				0	0%
	difficult				0	0%
P10	simple	•	•	•	3	100%
	challenging				0	0%
	difficult				0	0%
P11	simple	•	•		2	100%
	challenging				0	0%
	difficult			•	1	50%
P12	simple		•	•	2	67%
	challenging				0	0%
	difficult	•			1	33%

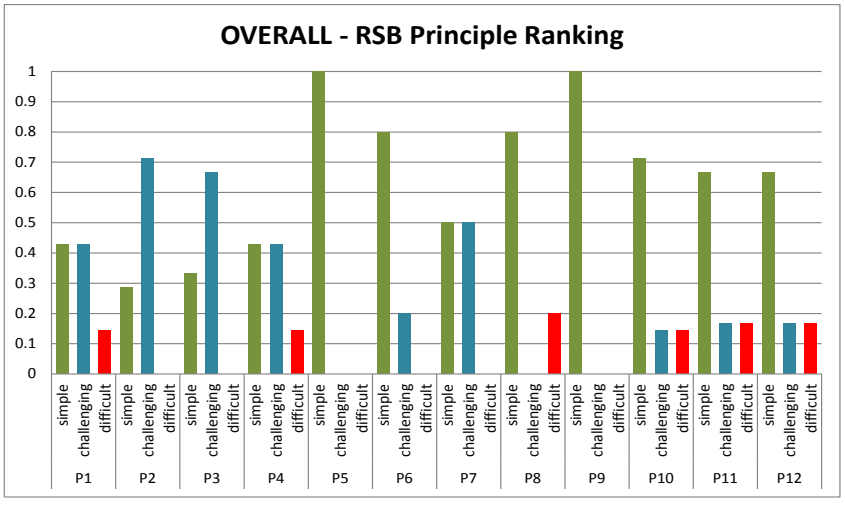


		GROUP 3
		SkyNRG
P1	simple	•
	challenging	
	difficult	
P2	simple	
	challenging	•
	difficult	
P3	simple	•
	challenging	
	difficult	
P4	simple	•
	challenging	
	difficult	
P10	simple	•
	challenging	
	difficult	
P11	simple	•
	challenging	
	difficult	



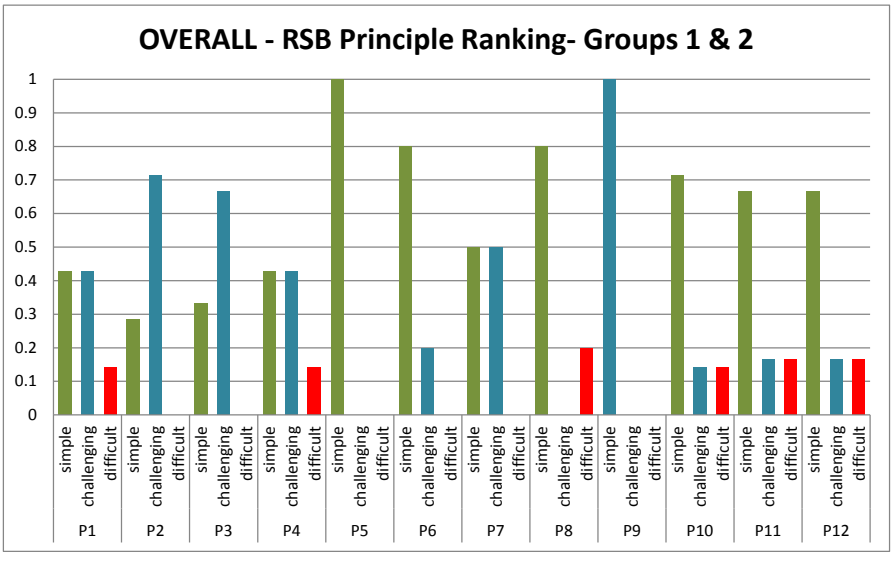
Overall Ranking

Principle	Ranking	Percentage
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	43%
	Challenging	43%
	Difficult	14%
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	29%
	Challenging	71%
	Difficult	0%
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	33%
	Challenging	67%
	Difficult	0%
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	43%
	Challenging	43%
	Difficult	14%
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	80%
	Challenging	20%
	Difficult	0%
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values.*	Simple	50%
	Challenging	50%
	Difficult	0%
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	80%
	Challenging	0%
	Difficult	20%
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	71%
	Challenging	14%
	Difficult	14%
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	67%
	Challenging	17%
	Difficult	17%
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	67%
	Challenging	17%
	Difficult	17%



Group 1 and Group 2 Overall Ranking

Principle	Ranking	Percentage
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	33%
	Challenging	50%
	Difficult	17%
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	33%
	Challenging	67%
	Difficult	0%
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	20%
	Challenging	80%
	Difficult	0%
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	33%
	Challenging	50%
	Difficult	17%
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	80%
	Challenging	20%
	Difficult	0%
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values.*	Simple	50%
	Challenging	50%
	Difficult	0%
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	80%
	Challenging	0%
	Difficult	20%
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	67%
	Challenging	17%
	Difficult	17%
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	60%
	Challenging	20%
	Difficult	20%
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	67%
	Challenging	17%
	Difficult	17%



Group Rankings

GROUP 1		
Principle	**Ranking**	**Percentage**
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	33%
	Challenging	67%
	Difficult	0%
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	67%
	Challenging	33%
	Difficult	0%
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	0%
	Challenging	100%
	Difficult	0%
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	33%
	Challenging	33%
	Difficult	33%
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	67%
	Challenging	33%
	Difficult	0%
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values.*	Simple	67%
	Challenging	33%
	Difficult	0%
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	67%
	Challenging	0%
	Difficult	33%
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	33%
	Challenging	33%
	Difficult	33%
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	50%
	Challenging	50%
	Difficult	0%
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	67%
	Challenging	33%
	Difficult	0%

GROUP 2		
Principle	**Ranking**	**Percentage**
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	33%
	Challenging	33%
	Difficult	33%
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	0%
	Challenging	100%
	Difficult	0%
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	33%
	Challenging	67%
	Difficult	0%
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	33%
	Challenging	67%
	Difficult	0%
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 6: Local Food Security *Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 7: Conservation *Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values.*	Simple	33%
	Challenging	67%
	Difficult	0%
Principle 8: Soil *Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 9: Water *Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	100%
	Challenging	0%
	Difficult	50%
Principle 12: Land Rights *Biofuel operations shall respect land rights and land use rights.*	Simple	67%
	Challenging	0%
	Difficult	33%

GROUP 3		
Principle	**Ranking**	**Percentage**
Principle 1: Legality *Biofuel operations shall follow all applicable laws and regulations.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 2: Planning, Monitoring and Continuous Improvement *Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative impact assessment and management process and an economic viability analysis.*	Simple	0%
	Challenging	100%
	Difficult	0%
Principle 3: Greenhouse Gas Emissions *Biomass and biomaterials shall contribute to climate change mitigation by significantly reducing lifecycle GHG emissions as compared to fossil fuels.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 4: Human and Labor Rights *Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers.*	Simple	100%
	Challenging	0%
	Difficult	0%
Principle 5: Rural and Social Development *In regions of poverty, biofuel operations shall contribute to the social and economic development of local, rural and indigenous people and communities.*	Simple	100%
Principle 10: Air *Air pollution from biofuel operations shall be minimized along the supply chain.*	Simple	0%
	Challenging	0%
	Difficult	100%
Principle 11: Use of Technology, Inputs, and Management of Waste *The use of technologies in biofuel operations shall seek to maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people.*	Simple	0%
	Challenging	0%
	Difficult	0%

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Fax: +1 (204) 958-7710
Website: www.iisd.org
Twitter: @IISD_news

IISD

IISD.ORG