# THE CHALLENGES FOR THE DEVELOPMENT AND DEPLOYMENT OF SUSTAINABLE ALTERNATIVE FUELS IN AVIATION

## OUTCOMES OF ICAO'S SUSTAF EXPERTS GROUP

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*This document presents the collective findings and conclusions of the SUSTAF Experts Group, a group of experts assembled by the International Civil Aviation Organization (ICAO) to analyse and provide technical and/or stakeholder feedback on the challenges related to the development of alternative fuels and their use in international civil aviation. It does not constitute the official view of ICAO nor that of any ICAO Member State.*

### *SUSTAF Experts Group:*

Jan Bode (Germany), Barbara Bramble (RSB), Tania Buenrostro (Mexico), Delia Dimitriu (Manchester University), Frédéric Eychenne (ICCAIA), Thimothy Fenouhlet (EC), Johnston Glenn (Gevo), James Hileman (USA), Nicolas Jeuland (France), Christoph Jessberger (Aireg), Virpi Kröger (Neste Oil), Michael Lunter (The Netherlands), Chris Malins (ICCT), Philippe Marchand (Total), Bruno Miller (Metron Aviation), Shumani Mugeri (South Africa), Philippe Novelli (ICAO), Xavier Oh (ACI), Martina Otto (UNEP), John Plaza (Imperium Renewables), Gerard Ostheimer (USA), James Rekoske (ICCAIA), Thomas Roetger (IATA), Shona Rosengren (Australia), Andrea Rossi (FAO), Arne Roth (Bauhaus Luftfahrt), Marcelo Saito (Brazil), Alfredo Iglesias Sastre (Spain), Andreas Sizmann (Bauhaus Luftfahrt), Laurens Van Sterkenburg (The Netherlands), Michael Sicard (France), Cindy Thyfault (Westar Trade Resources), Terry Thompson (Metron Aviation), Cesar Velarde Catolfi-Salvoni (Spain), Arnaldo Vieira de Carvalho (IDB), Hoang Vu Duc (EC), Kevin Welsch (USA), David White (Australia), Zheng Xingwu (China), Nancy Young (A4A).

**Coordinating and contact author:** Philippe Novelli, ICAO Environment Branch, pnovelli@icao.int

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# 1 Introduction

In 2010, the ICAO Assembly adopted Resolution A37-19, which included a global aspirational goal of maintaining the global net carbon emissions from international aviation from 2020 at the same level. Alternative fuels are part of the basket of measures that ICAO and its member States are pursuing to achieve this goal, along with improvements in technology, operations and infrastructure as well as economic measures. Assembly Resolution A37-19 encourages Member States and invites industry to actively participate in further work on sustainable alternative fuels for aviation.

Building on the outcomes of the ICAO Aviation and Sustainable Alternative Fuels (SUSTAF) Workshop held in October 2011 and on the discussions of the 194th Session of the ICAO Council, the SUSTAF Expert Group was created in June 2012 to develop recommendations relating to on-going challenges in the development and deployment of sustainable alternative fuels for aviation, with a view to supporting States and the industry in their efforts.

The Group focused its work on the identification of the major near-term challenges attendant to the deployment of sustainable alternative fuels for aviation and on the solutions to overcome them. In particular, the issue of the sustainability of such fuels was addressed and the group aimed to identify possible options States might use to address this issue. In the course of the work, additional considerations were also identified that may affect the deployment and are worth considering in the whole plan to facilitate the emergence of sustainable alternative fuels in aviation. The analysis led the group to a number of conclusions that support the recommendations issued towards ICAO Council.

In the context of the group's work, "sustainable alternative fuels" were understood to be consistent with the environmental, social and economic pillars of sustainability and, in particular, to be fuels that can have a lower life cycle greenhouse gas (GHG) footprint than conventional fuel. In agreement with ICAO's environmental goals, their use should result in the future, through continuous improvement, in significant reductions of greenhouse gas emissions compared to conventional jet fuel.

Only drop-in fuels were considered within the discussions of the group. Drop-in fuel that is fully compatible with current aircraft and infrastructure is seen as a required feature for short to medium-term deployment of alternative fuels.

In identifying the challenges for deployment as well as the variety of options for States to address sustainability, the group took into account the global nature of international aviation with aircraft operating worldwide over multiple geographic areas where different regional regulations apply. Similar to other areas of international aviation, coexistence of disparate policies and procedures could indeed be a challenge.

# 2 Major challenges for commercial- scale deployment of sustainable alternative fuels

## 2.1 Challenges

While the availability of sustainable feedstock and the impacts of their production in the required quantities is a significant challenge for a commercial-scale deployment of alternative fuels in aviation over the long term, overall economics appear as the main issue for the near-term. Today, the most significant challenge is stimulating the necessary investment in capital to ramp up the production.

To date, economic assessments of alternative fuels for aviation converge on a lack of competitiveness compared to conventional jet fuel, which will continue during the initial development phase before research and development, production technology progress and economies of scale bring cost reduction.

With no compensation mechanism for airlines for the environmental benefits of using the fuel, there are small, limited markets for aviation biofuels at the current price which is higher than for conventional jet fuel. Without the ability to compete on price, it is hard for companies in the entire value chain of alternative jet fuels to demonstrate their viability and complete financing for commercial projects.

In addition, advanced biofuels in general are currently perceived by investors and lenders as a less attractive investment that has more risk than other, more mature, renewable energy technologies, such as biomass to heat and power, wind or solar.

Furthermore, in the development of alternative fuels, aviation currently faces an unbalanced competition with road transportation. Indeed, producing alternative fuels for aviation is more costly than for road transportation because aviation's requirement for "drop-in" fuels calls for more advanced processes than those deployed for the first generation of road transportation biofuels (e.g. ethanol and FAME[1]) and for further upgrading of the fuel in order to meet jet fuel specifications. Beyond this, alternative fuels policies in their implementation tend to favour road transportation where more public research has been funded, blending mandates often apply and where tax levers are used to compensate the extra cost compared to conventional fuels.

Although there has been great success in the early development of aviation alternative fuels, this is a young sector where many technologies are not yet mature. Research and development are of major importance to accelerate the move towards commercial production by:

- improving the efficiency and decreasing the cost of the feedstock and fuel production;
- qualifying additional emerging production pathways (such as alcohol to jet, pyrolysis, catalytic and direct methods of converting 'sugars' to hydrocarbons, etc.) for use in aviation;
- bringing new production pathways from laboratory to commercial scale.

Beyond research, demonstrating a biojet technology at a sufficient scale is a critical step in the development to convince investors of the viability of the technology and complete the fuel approval process. It also provides a base to build larger commercial facilities at economies of scale. The cost of such demonstrations ranges from US$ 20 to 50 million and is a real barrier for technology start-up.

[1] Fatty Acid Methyl Esters, commonly called biodiesel.

Changes in regulations and policies are also strong concerns for the development of the industry. With a favourable context for the development of alternative fuels in aviation, the time frame is currently projected to be not less than ten to fifteen years for a biojet pathway to reach established commercial production from the demonstration step. A stable regulatory and political perspective over ten years or more is thus required from the States to attract investors in the development and deployment of alternative fuel technologies for aviation.

## 2.2 Possible solutions

A priority for the deployment of sustainable alternative fuels in aviation is to create a long-term market perspective and address the initial price gap with conventional jet fuel in order to initiate viable commercial production. A first step in that direction is for States to include sustainable aviation fuels in their global renewable energy and biofuels policies.

A number of measures can be considered to promote the deployment of sustainable alternative fuels in aviation. From the experience with incentives and supporting measures, the following trends are observed that provide indications to design supporting policy.

Access to commercial loans and other conventional funding options for the development of advanced biofuels proves to be difficult due to the technology risk and, in case of biojet, of market uncertainties. The renewable fuels companies that have received government guaranteed loans are those that can produce fuels at the current market price, that have been able to establish long-term sales agreements at prices aiming at parity with conventional fuels, and that have answered technology concerns regarding the commercial scale-up.

Loan guarantees are important instruments to help with financing for facilities but by themselves do not assist in creating the market. They do not provide any bridge or subsidy rate for the extra cost of alternative fuels and thus are not a tool for offsetting the initial price gap between alternative fuels and conventional fuels.

Mandate policy has proven to be efficient in developing the production of biofuels when the industry had reached the commercial stage and the business model was well understood. For aviation, alternative fuels have not yet reached this level of development so that mandate could be premature. Mandates also need to be derived  based on a solid resource assessment and flanked by sustainability indicators in order to determine the sustainably feasible potential. There are nevertheless parts of the possible options to support industry scale-up. Careful attention should then be paid to the accompanying sustainability assurance as well as to the international context of aviation operations and related competition issues.

Finally, grants and tax exemptions have been widely used by countries for the promotion of renewable energies and have demonstrated significant efficiency. Tax reduction on the final products is a common practice for road transportation fuels. This is not relevant for international aviation but could be implemented on some domestic markets where taxes are applied on jet fuel. Examples of other forms of tax incentives include tax credits for the development of wind energy in the United States or tax breaks for sugar cane ethanol in Brazil. A large panel of measures can be considered at the different levels of the value chain to support the initial development of the industry.

As part of the possible measures to create the market perspective and support the initial development, States could use grants, tax incentives and other forms of assistance to encourage and support research and development in technology processes and feedstock production in order to decrease costs, meet price parity with conventional jet fuel and increase maturity of the sector. In a similar way, they could support the development and scale-up of production pathways up to commercial scale through funding of demonstration steps and fuel approval. Last, States could use long-term fuel purchases by States for use in military or other state-owned aircraft, eventually associated with grouped airlines procurement in order to provide a stable sales platform and offset the customer risk.

A possible option for incentivizing sustainable alternative fuels for aviation might also be to qualify them for reduced emissions accounting in the framework of measures related to aviation's greenhouse gas emissions.

# 3 Additional considerations for the deployment

## 3.1 Feedstock

Sustainable feedstock supply is a critical point to develop sustainable alternative fuels projects. Feedstock is indeed a major contributor in the cost of alternative fuels. As such, it needs to be included in supporting policies as well as in the research and development effort.

In addition, securing a long-term sustainable feedstock supply at competitive prices together with long-term sales agreements with end-users is a key asset for an alternative jet fuel project to be financed. From this point of view, involving feedstock producers in the beginning stage of the development process provides needed input and commitment from which to develop the project. Preparing long-term feedstock and sales agreement contracts in a manner that decouples the feedstock cost from the current fossil fuel market is also an important long-term viability guideline.

Therefore, building an integrated value chain from the beginning of the project development is a pathway to secure both feedstock supply and sales agreement. It could provide an efficient model in the initial deployment phase of alternative fuels in aviation on which States may have interest to concentrate their support.

An integrated approach to alternative fuel production for aviation should also consider the associated co-products and their valuation. It could improve the global sustainability through the opportunities for cascading use of the feedstock.

In the development of biomass production for alternative fuels, the implementation of new agricultural practices and the need for the use of new forms of harvesting and transportation equipment represent a significant effort and investment. This should be taken into account together with agro-climatic characteristics, logistics and infrastructure considerations in the mapping of the most suitable areas for energy biomass development. It should, however, be underlined that once this barrier is broken, it can lead to significant progress on scale, cost and overall environmental benefit from the use of alternative fuels. This may also be compulsory for the deployment of emerging advanced technologies.

### 3.2 Operational aspects

In the effort to facilitate the development and deployment of alternative fuels in aviation, a number of operational aspects should not be forgotten.

Recognizing that safety is paramount for the acceptance of technically suitable alternative aviation fuels, confidence should be given to airlines that any alternative fuels for aviation are provided on a continuous basis with the same level of suitability and quality than conventional fuels. This entails a thorough approval using internationally recognized standards such as ASTM and the supply of the fuel through the same internationally accepted standards of quality control, all along the logistical steps of the multiple value chains that will be created for alternative aviation fuels.

In an incentive policy for the deployment of alternative fuels, airlines should be recognized for the use of the fuel and a practical system to account for their consumption need to be set up. In most airports, alternative fuels will be delivered through the same supply infrastructure as conventional jet fuel and will be mixed with it in airports' fuel farms. Hence, there will be no direct link between the fuel bought by a particular airline and the aircraft to which the fuel is delivered. The use of alternative fuels by the airlines should thus be recognized on the basis of the purchase, in what often is referred to as a "book and claim" accounting process.

Local administrative processes or policies affecting feedstock production and logistics implementation can also be bottlenecks that should not be underestimated in the deployment of alternative fuels for aviation. Some examples include the registration, protection and authorization of energy crops or the crop insurance for farmers.

## 4 Sustainability and possible options for a sustainable commercial-scale deployment

A significant motivator for deploying alternative fuels in aviation is their potential, if properly produced, to reduce aviation GHG emissions and to contribute to ICAO's goal of carbon neutral growth from 2020. GHG emissions over the whole life cycle of the fuels are thus of particular interest.

Sustainability does not however reduce to GHG emissions. Applied to alternative fuels, sustainability means the preservation of a long-term continued production capacity of natural resources, on an economically feasible, socially and environmentally acceptable way. The management and control of environmental, social and economic impacts are the three pillars of the successful sustainable development of aviation alternative fuels.

Sustainability of a particular fuel cannot be assumed and needs to be demonstrated. It depends mostly on the way the feedstock and the fuel are produced or sourced. It also depends on the interaction between the production, other activities and the global ecosystem. GHG emissions associated with alternative fuels, like other environmental, social and economic performance attributes of alternative fuels, are directly determined by the conditions of production.

While the three pillars of sustainability are well accepted[2], there is no globally recognized approach to determining sustainability for alternative fuels. Three complementary approaches have been deployed to define and address sustainability: 1) consideration of sustainability indicators, such as those identified by the Global Bioenergy Partnership (GBEP), 2) implementation of voluntary standards and certification schemes; and 3) regulations introduced in some States or group of States.

***Sustainability Indicators:*** GBEP, an international initiative bringing together public decision-makers, representatives of the private sector and civil society as well as international agencies, has defined a set of 24 indicators of sustainability for bioenergy production[3]. These indicators are intended to provide guidance on analysis that may be undertaken for bioenergy at the domestic level with a view to informing decision making and facilitating the sustainable development of bioenergy. The GBEP approach is non-prescriptive. Measured over time, the indicators show progress towards or away from a nationally defined sustainable development path. They are value-neutral, do not feature directions, thresholds or limits and do not constitute a standard, nor are they legally binding.

***Voluntary Sustainability Standards and Certification Schemes:*** they propose a set of sustainability principles, further detailed in criteria, with guidelines to fulfill the criteria and indicators to measure compliance. Many systems have emerged, independently of the bioenergy debate, from the willingness of specific value chains like sugarcane, palm oil, or soy to improve their sector specific practices[4]. Schemes were more generally designed for biomass and bioenergy or, in the case of RSB[5] more specifically for biofuels. The overarching principle is that a producer voluntarily seeks certification from a third party to get a comparative advantage from demonstrating the sustainability of its products.

***Sustainability Regulations:*** some States have introduced sustainability criteria within biofuel or bioenergy policies where compliance is required for the fuels to be recognized in the application of the policy and to benefit from supporting measures. Examples appear in the Renewable Energy Directive[6] in Europe, the Renewable Fuels Standards programme[7] in the United States and the alternative fuel production provisions in Brazil[8]. The U.S. regulations primarily address global environmental impacts related to GHG emissions, while the European regulations also consider biodiversity. Both are applied to

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2 UN 2005 World Summit Outcome (United Nation General Assembly – October 2005)

3 http://www.globalbioenergy.org/programmeofwork/task-force-on-sustainability/gbep-report-on-sustainability-indicators-for-bioenergy/fi/

4 A compilation of bioenergy sustainability initiatives has been done by FAO/BEFS and is available at http://www.fao.org/energy/befs/compilation/en/.

5 Initially "Round-table on Sustainable Biofuels", it has now enlarged its scope and become "Round-table on Sustainable Biomaterial" (http://rsb.org/).

6 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

7 http://www.epa.gov/otaq/fuels/renewablefuels/index.htm

8 R.M. Teixera de Andrade – Policies and institutional and legal frameworks in the expansion of Brazilian biofuels – CIFOR working paper 71, 2011.

domestically produced and imported biofuels. Brazilian regulations include a set of environmental and social requirements on domestic production[9].

These existing approaches represent a significant and still progressing effort. They each respond to distinct types of needs and objectives, and they have complementary roles in insuring a sustainable development of alternative fuels which may require to combine them with each other's in States' alternative fuels policy. Indicators, by what they are designed for, are useful measurement tools for monitoring but need to be associated with a policy defining principles and targets. On their side, sustainability regulations may only require compliance with a limited number of criteria and not cover all aspects of sustainability (in particular for compliance with international rules), which makes voluntary certification systems valuable complementary tools. However, if these systems are efficient to evaluate individual value-chains, not all impacts may be fully assessed at this level, which is in particular the case for cumulative impacts of biofuels commercial-scale deployment or for the competition for resources between food , feed, fibre and bio-energy sectors. There, monitoring at regional or national level is a relevant complementary approach.

Last, commercial-scale deployment of alternative fuels may induce indirect impacts, such as impacts on the global food market or land use change in other geographic areas due to the displacement of previously existing cultures (a phenomena referred as indirect land use change and recognized to possibly induce GHG emissions). Neither indicators nor existing regulations applied at a national level may be able to fully address these indirect impacts which can also not be handled at value-chain level by voluntary certifications schemes. Therefore, existing approaches to ensuring sustainability for alternative fuels, while providing already a strong basis for sustainability policies, have the potential for further improvements and may require to be complemented by additional measures.

Given that existing voluntary standards and certification schemes were designed over time to answer sectorial needs, it is also worth noting that they vary in their level of ambition and coverage, the way they have been developed, and how they are implemented. From that perspective, increased convergence and cooperation, without compromising on the level of requirements, could yield benefits.

In the field of regulation, different regional systems are also emerging. If not harmonized or accompanied by mutual recognition mechanisms, this could hinder commercial-scale deployment of alternative fuels for aviation. An example is the implementation of different requirements on life cycle GHG emissions, which may not only differ in threshold value but could be based on non-comparable methodologies.

# 5 Conclusion

The balance between environmental benefits and the cost of deploying alternative fuels is deemed to be important to States and may currently look more favourable for deployment in road transportation. However, it is important to include aviation fuels in the alternative fuels policies of States. Indeed, aviation has no alternative to liquid fuels in a foreseeable future, unlike road transportation which has

[9] EU RED includes requirements on agricultural practices for domestic production.

electricity or fuel cell options. Aviation is also keen to use sustainable alternative fuels to improve its environmental friendliness. Airlines have been very proactive in demonstrating their feasibility through flight tests and more than 1,500 commercial flights. All aviation industry stakeholder groups, Airports Council International (ACI), International Air Transport Association (IATA), International Coordinating Council of Aerospace Industries Associations (ICCAIA), in coordination with ICAO, foster their use. Furthermore, the aviation concentrated infrastructure (over 80 per cent of the world's air traffic is operated by just over 200 airlines and through 190 airports) might be an advantage to deploy alternative fuels with less infrastructure and logistics than in road transportation. Airports' ground-based operations, such as auto rentals and ground-based cargo delivery, also provide demand for other fuels produced along with alternative jet fuel.

With regard to short-term deployment of alternative fuels, the first need is to create a long-term market perspective and address the initial price gap with conventional jet fuel in order to convince investors and initiate viable commercial production. This requires a combination of measures and the inclusion of aviation in States' global renewable energy and biofuels policies.

Provisions and measures to ensure the sustainability of the fuels need to be part of these policies. In addition, incentives and policies by States should have a long-term stable view for ten years or more in order to provide market assurance for investors and to allow the industry to develop.

Developing and deploying alternative fuels in aviation is a multidisciplinary issue closely connected to other renewable energy policies. It calls for an interdepartmental approach coordinating energy, environment, agriculture and transport with aviation. This approach should include:

a) Evaluating biomass resources and support solid biomass production planning by mapping the most suitable areas for its development considering agro-climatic characteristics, logistics and existing infrastructure as well environmental protection criteria, and taking into account competing demands for biomass for food, feed and fibre;
b) Allocating aviation's share in the global picture of energy demand;
c) Facilitating the implementation of policy and address administrative barriers with clear, understandable and implementable processes and procedures;
d) Assessing all impacts of commercial-scale deployment.

Developing public/private stakeholder groups is also a way to facilitate the development of the renewable jet fuel industry, and support building of complete value chains. Examples include the Commercial Aviation Alternative Fuels Initiative (CAAFI), the Aviation Initiative for Renewable Energy in Germany (AIREG), Australian Initiative for Sustainable Aviation Fuels (AISEF) and the Brazilian Alliance for Aviation Biofuels (ABRABA), Bioqueroseno and Biofuels Flightpath initiatives.

Regarding sustainability, the group agreed that the following general principles should be considered for the deployment of alternative fuels in aviation:

a) Sustainable alternative fuels produced for aviation should achieve a net reduction of GHG emissions on a life cycle basis, compared to the use of conventional jet fuel, with a particular attention to be paid to the carbon stocks of the land converted for the feedstock production and to continuous progress towards higher emissions reductions;

b) Areas of high importance for biodiversity, conservation and ecosystem services[10] should be identified and preserved;
c) Sustainable alternative fuels produced for aviation should contribute to local social and economic development; and competition with food should be minimized.

Beyond these principles, States should build on existing approaches to determining sustainability of alternative fuels to develop their policy and monitor at national level the impacts of a commercial scale deployment. Improvements and complementary measures are also required, in particular with view to global and indirect impacts of such deployment.

Finally, an increased convergence between national policies or the definition of mechanisms for interoperability and mutual recognition should be sought by States as it would significantly facilitate the deployment of sustainable alternative fuels in aviation. This applies to both technical suitability and sustainability of the fuels.

[10] Millennium Ecosystems Assessment: "Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth" − Ecosystems and Human Well-being − A Framework for Assessment.
http://www.millenniumassessment.org.

# Appendix A

## EXISTING APPROACHES TO SUSTAINABILITY

## The GBEP indicators (http://www.globalbioenergy.org)

The purpose of the Global Bioenergy Partnership is to provide a mechanism for Partners to organize, coordinate and implement targeted international research, development, demonstration and commercial activities related to production, delivery, conversion and use of biomass for energy, with a focus on developing countries.

GBEP's main functions are to:

- promote global high-level policy dialogue on bioenergy and facilitate international cooperation;
- support national and regional bioenergy policy-making and market development;
- favour the transformation of biomass use towards more efficient and sustainable practices;
- foster exchange of information, skills and technologies through bilateral and multilateral collaboration;
- facilitate bioenergy integration into energy markets by tackling specific barriers in the supply chain; and
- act as a cross-cutting initiative, working in synergy with other relevant activities, avoiding duplications.

The Partnership brings together public decision-makers, representatives of the private sector and civil society as well as international agencies with expertise in bioenergy.

The GBEP Task Force on Sustainability, established in 2008 under the leadership of the United Kingdom, and then of Sweden, has released in December 2011 its report “The Global Bioenergy Partnership Sustainability Indicators for Bioenergy”.

The report presents 24 voluntary sustainability indicators for bioenergy intended to guide any analysis undertaken of bioenergy at the domestic level with a view to informing decision-making and facilitating the sustainable development of bioenergy and, accordingly, shall not be applied so as to limit trade in bioenergy in a manner inconsistent with multilateral trade obligations.

The GBEP sustainability indicators do not feature directions, thresholds or limits and do not constitute a standard; nor are they legally binding on GBEP Partners. They shall not be applied so as to limit trade in bioenergy in a manner inconsistent with multilateral trade obligations. The indicators are meant to guide analysis at the domestic level and to inform decision-making.

Each indicator was developed with three parts: a name, a short description and a multi-page methodology sheet that provides in-depth information needed to evaluate the indicator.

| PILLARS<br>GBEP's work on sustainability indicators was developed under the following three pillars, noting interlinkages between them: | | |
|---|---|---|
| **Environmental** | **Social** | **Economic** |
| **THEMES**<br>GBEP considers the following themes relevant, and these guided the development of indicators under these pillars: | | |
| Greenhouse gas emissions, Productive capacity of the land and ecosystems, Air quality, Water availability, use efficiency and quality, Biological diversity, Land-use change, including indirect effects. | Price and supply of a national food basket, Access to land, water and other natural resources, Labour conditions, Rural and social development, Access to energy, Human health and safety. | Resource availability and use efficiencies in bioenergy production, conversion, distribution and end use, Economic development, Economic viability and competitiveness of bioenergy, Access to technology and technological capabilities, Energy security/Diversification of sources and supply, Energy security/Infrastructure and logistics for distribution and use. |
| **INDICATORS** | | |
| 1. Lifecycle GHG emissions | 9. Allocation and tenure of land for new bioenergy production | 17. Productivity |
| 2. Soil quality | 10. Price and supply of a national food basket | 18. Net energy balance |
| 3. Harvest levels of wood resources | 11. Change in income | 19. Gross value added |
| 4. Emissions of non-GHG air pollutants, including air toxics | 12. Jobs in the bioenergy sector | 20. Change in consumption of fossil fuels and traditional use of biomass |
| 5. Water use and efficiency | 13. Change in unpaid time spent by women and children collecting biomass | 21. Training and requalification of the workforce |
| 6. Water quality | 14. Bioenergy used to expand access to modern energy services | 22. Energy diversity |
| 7. Biological diversity in the landscape | 15. Change in mortality and burden of disease attributable to indoor smoke | 23. Infrastructure and logistics for distribution of bioenergy |
| 8. Land use and land-use change related to bioenergy feedstock production | 16. Incidence of occupational injury, illness and fatalities | 24. Capacity and flexibility of use of bioenergy |

## Example of voluntary standard and certification scheme: the Round Table for Sustainable biofuels (RSB – rsb.epfl.ch)

The Round Table for Sustainable Biofuels (RSB) is presented here as an example of the existing voluntary standard and certification schemes as it is the only scheme that was specifically designed for biofuel value chains. In addition, this scheme has also received the support of aviation organizations, such as SAFUG or IATA, who are members of the RSB.

The RSB presents a detailed framework covering a broad scope of sustainability aspects with key as well as a complete set of instruments:

- the principles and criteria are commented in a guidance document;
- they are completed by a precise set of more than 250 indicators of compliance; and
- several guidelines documents have been published in association with the 12 principles, providing a detailed approach to improve the sustainability of any biofuel.

The following tables present the principles and associated criteria considered for biofuel production certification under the RSB voluntary certification scheme.

| Principles | Criterion | Sub-criteria |
|---|---|---|
| Legality | Biofuel operations shall follow all applicable laws and regulations. | Biofuel operations shall comply with all applicable laws and regulations of the country in which the operation occurs and with relevant international laws and agreements. |
| Greenhouse gas emissions | Biofuels shall contribute to climate change mitigation by significantly reducing life cycle GHG emissions as compared to fossil fuels. | In geographic areas with legislative biofuel policy or regulations in force, in which biofuel must meet GHG reduction requirements across its life cycle to comply with such policy or regulations and/or to qualify for certain incentives, biofuel operations subject to such policy or regulations shall comply with such policy and regulations and/or qualify for the applicable incentives. |
| | | Life cycle GHG emissions of biofuel shall be calculated using the RSB life cycle GHG emission calculation methodology. |
| | | Biofuel blends shall have on average 50% lower life cycle greenhouse gas emissions relative to the fossil fuel baseline. Each biofuel in the blend shall have lower life cycle GHG emissions than the fossil fuel baseline. |
| Conservation | Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and other conservation values | Conservation values within the potential or existing area of operations shall be identified through a land-use planning process. Conservation values of local, regional or global importance within the potential or existing area of operation shall be maintained or enhanced |
| | | Ecosystem functions and services that are directly affected by biofuel operations shall be maintained or enhanced |
| | | Biofuel operations shall protect, restore or create buffer zones |
| | | Ecological corridors shall be protected, restored or created to minimize fragmentation of habitats |
| | | Biofuel operations shall prevent invasive species from invading areas outside the operation site. |
| Soil | Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health | Operators shall implement a soil management plan designed to maintain or enhance soil physical, chemical, and biological conditions |

| Principles | Criterion | Sub-criteria |
|---|---|---|
| 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 | Biofuel operations shall respect the existing water rights of local and indigenous communities. |
| | | Biofuel operations shall include a water management plan which aims to use water efficiently and to maintain or enhance the quality of the water resources that are used for biofuel operations |
| | | Biofuel operations shall not contribute to the depletion of surface or groundwater resources beyond replenishment capacities |
| | | Biofuel operations shall contribute to the enhancement or maintaining of the quality of the surface and groundwater resources |
| Air | Air pollution from biofuel operations shall be minimized along the supply chain | Air pollution emission sources from biofuel operations shall be identified, and air pollutant emissions minimized through an air management plan. |
| | | Biofuel operations shall avoid and, where possible, eliminate open-air burning of residues, wastes or by-products |
| 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. | Information on the use of technologies in biofuel operations shall be fully available, unless limited by national law or international agreements on intellectual property |
| | | The technologies used in biofuel operations including genetically modified: plants, micro-organisms, and algae, shall minimize the risk of damages to environment and people, and improve environmental and/or social performance over the long term. |
| | | Micro-organisms used in biofuel operations which may represent a risk to the environment or people shall be adequately contained to prevent release into the environment |
| | | Good practices shall be implemented for the storage, handling, use, and disposal of biofuels and chemicals |
| | | Residues, wastes and by-products from feedstock processing and biofuel production units shall be managed such that soil, water and air physical, chemical, and biological conditions are not damaged |

| Principles | Criterion | Sub-criteria |
|---|---|---|
| Human and labour rights | Biofuel operations shall not violate human rights or labor rights, and shall promote decent work and the well-being of workers | Workers shall enjoy freedom of association, the right to organize, and the right to collectively bargain. |
| | | No slave labor or forced labor shall occur. |
| | | No child labor shall occur, except on family farms and then only when work does not interfere with the child's schooling and does not put his or her health at risk |
| | | Workers shall be free of discrimination of any kind, whether in employment or opportunity, with respect to gender, wages, working conditions, and social benefits |
| | | Workers' wages and working conditions shall respect all applicable laws and international conventions, as well as all relevant collective agreements. Where a government regulated minimum wage is in place in a given country, this shall be observed. Where a minimum wage is absent, the wage paid for a particular activity shall be negotiated and agreed on an annual basis with the worker. Men and women shall receive equal remuneration for work of equal value. |
| | | Conditions of occupational safety and health for workers shall follow internationally-recognized standards. |
| | | Operators shall implement a mechanism to ensure the human rights and labor rights outlined in this principle apply equally when labor is contracted through third parties |
| 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. | In regions of poverty, the socioeconomic status of local stakeholders impacted by biofuel operations shall be improved |
| | | In regions of poverty, special measures that benefit and encourage the participation of women, youth, indigenous communities and the vulnerable in biofuel operations shall be designed and implemented |

| Principles | Criterion | Sub-criteria |
|---|---|---|
| Land rights | Biofuel operations shall respect land rights and land use rights | Existing land rights and land use rights, both formal and informal, shall be assessed, documented, and established. The right to use land for biofuel operations shall be established only when these rights are determined |
| | | Free, Prior, and Informed Consent shall form the basis for all negotiated agreements for any compensation, acquisition, or voluntary relinquishment of rights by land users or owners for biofuel operations |
| Planning, monitoring and continuous improvement | Sustainable biofuel operations shall be planned, implemented, and continuously improved through an open, transparent, and consultative Environmental and Social Impact Assessment (ESIA) and an economic viability analysis. | Biofuel operations shall undertake an Environmental and Social Impact Assessment (ESIA) to assess impacts and risks and ensure sustainability through the development of effective and efficient implementation, mitigation, monitoring and evaluation plans. |
| | | Free, Prior & Informed Consent (FPIC) shall form the basis for the process to be followed during all stakeholder consultation, which shall be gender sensitive and result in consensus-driven negotiated agreements. |
| | | Biofuel operators shall implement a business plan that reflects a commitment to long-term economic viability. |