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SUSTAINABILITY CRITERIA AND INDICATORS FOR BIOENERGY

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1. Why sustainability criteria and indicators for biomass energy?

The international context of looming oil shortages and climatic changes caused by burning of fossil fuels, along with the characteristics of the Brazilian economy, are expected to contribute to a dramatic growth in production of energy from biomass in the first decades of the 21st century.

The history of Brazil's economic development has been closely linked to the use of biomass energy. From the early days of colonization based on sugarcane plantations, to the tree plantations for energy for the steel industry and the alcohol program in the final decades of the 20th century, and more recently the federal government biodiesel program, there have been a wide variety of public policies and private investments aimed at developing management mechanisms able to bring about a rapid expansion in the scale of production of this source of energy. However, this same process has left a cruel legacy in devastation of ecosystems, concentration of income and the expulsion of traditional populations from their lands.

The Energy Working Group (GTE) of the Brazilian Forum of NGOs and Social Movements (FBOMS), with the experience of its members in dealing with populations affected by energy projects, hopes that this paper will contribute to ensuring that the expansion of energy supply from biomass – whether through liquid bio-fuels, electricity generation from plant residues and other biomass sources – planned for the coming years, occurs in a manner that respects traditional cultures and ways of life, promotes social inclusion and local sustainable development, while at the same time contributes to replacing fossil fuel use and reducing associated problems of pollution and global warming.

This paper presents a set of criteria and indicators of sustainability for the generation of renewable energy from biomass, discussed within the Energy Working Group of FBOMS, in an attempt to contextualize and deepen the national and international debate about future initiatives, in a participatory and engaged manner. The consolidation of these proposals could make them a tool for organizations and movements from Brazilian civil society to influence national and international policies being developed or implemented in this area, as is the case of the 2nd phase of PROINFA, the national Biodiesel Program, the National Agro-energy Policy, the Clean Development Mechanism (CDM) and the international trade negotiations involving bioenergy.

2. Basic principles for the development of sustainability criteria and indicators for energy from biomass

The purpose of this report is to develop a set of sustainability criteria and indicators to guide the discussion between the various social and economic stakeholders involved in biomass energy projects, covering social, environmental and economic dimensions.

In this document, ***sustainability criteria*** are understood as a set of definitions of the different aspects that should be considered in the evaluation of initiatives, in a complementary and interdependent manner, linked to goals and principles related to the socio-environmental development of the country and its different populations. ***Sustainability indicators*** are understood as parameters that can be used as a measure of compliance with these criteria.

In defining the criteria and indicators, we started with the following principles:

Principle of a vision of a sustainable future

The initiatives must be analyzed in terms of their sustainability based on a vision of the country's future, which goes beyond the analysis of the specific projects. The question of energy production, even if renewable, cannot be disassociated from a context and the desire for development of a new model of society, which considers the strengthening of agro-ecology and family agriculture as a transformative model with self-sufficiency in food and energy; prudent and efficient use of natural resources; improvement of income distribution; social accountability of what is produced and how; decentralization of production and consumption and the lowest possible impact on natural biomes.

In terms of biomes, given the advanced stage of degradation of the Atlantic Forest, the *Cerrado* and the Southern Plains, and given the acceleration of processes of degradation of other biomes such as the Amazon Forest, any new initiatives must not pose a threat to them, but should rather contribute to their restoration, such that future generations can enjoy the economic benefits of these biomes as well as their contribution to pleasure and enjoyment.

Principle of environmental justice

Environmental justice must be treated as a basic principle of sustainability, which means considering the democratic access to natural resources and ensuring that the least possible burden of economic development falls on poor populations, including urban, rural and indigenous. At stake here is the building of a sustainable society, and not merely assessing the viability or sustainability of projects involving narrow economic interests. This means that the actions and measures of a political or economic nature aimed at development must be anchored in long term objectives, and in the use of natural resources in a sustainable manner, which promotes equity and respect for social, gender and cultural differences.

Principle of social interest

According to which energy production initiatives must support above all social inclusion and access to energy services, and not specific interests of energy-intensive economic sectors.

Principle of autonomy

According to which initiatives must contribute to the energy independence of communities and peoples, to technological innovation, the use of appropriate technologies, tech transfer, the development of domestic technologies through the use of existing Scientific, Technology and Information resources, and to the decentralization of energy generation.

Principle of prior assessment

Based on the principle that sustainability of projects with significant impacts must be assessed in terms of their individual and cumulative impacts prior to their economic, financial, institutional and technical assessment.

Principle of Ecological Economics

Since the economic system is a subsystem of the greater whole that it is a part of, which over the long term imposes an absolute limit on its expansion, it is necessary that the ecological limits on the economy, taking into considerations the impacts of technological progress, be respected and addressed in the model of development to be adopted. The short term profit objective must be replaced by others in pursuit of development built on the prudent and efficient use of natural resources. The unnecessary material and energy flows characteristic of the current globalized economy must be avoided, making way for decentralized and diversified socio-economic systems with greater potential for self-sufficiency and with the capacity for solidary integration with neighboring systems and peoples, which doesn't require their exploitation for meeting economic needs.

3. General sustainability criteria and indicators for energy production

3.1 Social accountability

The social accountability of energy projects requires that the affected population and the beneficiaries understand "why" and the "for who" the energy is produced – In other words, the role a particular technique, company or project plays in the local socio-environmental context and in the construction of a sustainable society. The mechanisms for social accountability must be capable of including local representatives and also representatives of the nationally organized civil society, who are able to prepare guidelines for the projects that harmonize the interests of local society with national interests.

Possible indicators of social accountability include participation of representatives of socio-environmental organizations; participation of the communities as decision-makers and not only being consulted; the degree of inclusion of the local population in the project design, and knowledge of the proposal and the alternatives.

3.2 Participation in decision-making

The assessment and management of socio-environmental impacts of projects is not sufficient to avoid conflicts. Social participation should be understood as the effective influence on decisions, which is different from the mere presence of parties affected by the project in meetings, such as public hearings, seminars, events. It is essential that affected parties have the capacity to participate effectively, which means communities and their representatives should receive training and capacity-building in effective intervention. It is also fundamental that the spaces where actors can effectively influence decision-making are clearly established, which is not the case in current licensing processes.

According to the Climate Observatory:

"The modalities should be established through which the proponent must develop a process of ***engagement*** *and* ***consultation with the***

interested parties *and early* ***dissemination of information****.*

Interested party is understood as individuals and groups directly and indirectly affected by a project, with an interest in and/or the capacity to influence its outcome.

Engagement is understood as the participation of this public in all stages of the project, starting with its conception.

Consultation is understood as a administrative tool for communication between the proponent and the public, which can be conducted through public hearings, research, questionnaires, workshops, visits, etc., whose objective is to identify all the actors involved and the socio-environmental scope of the impacts so as to establish a process for involvement of these actors in the process of formulation, implementation and monitoring of the project.

The information necessary to the appropriate participation of the public in this consultation must be disseminated in advance with the necessary publicity to reach all the publics, directly or indirectly affected by the project. The objective is to enrich the decision-making process through the active involvement of the relevant actors involved in the project"[6].

Possible indicators of participation in decision-making include the number, places and different forms of consultation, with emphasis on holding the consultations in the sites demanded by society; the accessibility of the sites of consultation for the affected populations; the different forms of publicity used; the effectiveness of access to information, in the native language and in an accessible format.

3.3 Type of project management

Projects must be capable of bringing concrete benefits to the affected population, especially in terms of creation of jobs and income (see criteria 3.4).Above all, they must be capable of involving a significant portion of the local population which so wishes in activities that can improve their living conditions and that of their families, preferably through cooperatives of family farmers or community associations with specific financing.

Possible sustainability indicators of the form of and participation in management include the structure of decision-making processes; the number of voters and decision-makers; involvement of representative organizations of local workers in the project management; participation of women in the cooperatives and associations and in management positions; and participation of traditional populations.

3.4 Job creation and income generation

It's not enough for projects to have a positive net balance in terms of job creation if this is at the cost of unemployment of the local population or their involvement in contracts that create new forms of submission, which is how workers often view the contracts involving integrated production systems often used in agribusiness. It should be noted that in most assessments of the number of jobs created by a given project, no consideration is given to the positions and job potential that could be impacted by the project.

Projects should to the greatest extent possible promote family farmers throughout the production chain, create jobs and good working conditions for the population and youth in the area of the project.

Similarly, the question of income must be assessed through the analysis of the increase in acquisitive power, which is not always given simply through financial remuneration, but also involves the capacity for production and exchange of basic local goods and services, as well as the strengthening of local markets and systems such as solidary grassroots economic networks. After all, increased income and income generation should result in improved living conditions, and not be seen only in terms of monetary value.

Possible indictors for job creation and income generation are the number of jobs or positions per unit of energy produced throughout the entire chain of production, including the construction/implementation and operations phase; participation of proponents and the local population in profits from the project; the generation of new local opportunities and local income; the relation between local jobs before and after the project; indexes of increased acquisitive power in the local population, etc.

3.5 Social inclusion

In a society so divided and exclusionary as Brazil's, any new project should include socio-environmental development as one of its leading objectives. Thus, they should consider training and sharing of the knowledge and be managed with a high degree of social responsibility, both in regards to the

[1] Critérios de Sustentabilidade para Projetos de MDL no Brasil; adapted from the paper written by Silvia Llosa for the Instituto de Pesquisa Ambiental da Amazônia (IPAM) and the Observatório do Clima by CES-FGV

internal and external publics.

Possible indicators of social inclusion are the number of families previously without access to energy who benefit from the project; measures of quality and compliance with accepted standards of the involuntary resettlements, when necessary and accepted; measures of impact on the quality of life of the communities; scope and quality of social programs, especially for health and education; epidemiological assessment and monitoring; contribution to access to services and infra-structure on the part of local populations to education, energy, garbage and sewage services, etc.; contribution to adult literacy and environmental education; indicators of reduction of violence and vulnerability of women and youth.

3.6. Gender equality

Long before we had electricity and liquefied petroleum gas (LPG), it was always the women who took responsibility in the family for controlling and maintaining the stock of firewood for cooking food, for heating water and for conserving products like fruit, vegetables and meat. But it was principally the men who were owners of lands and held key positions in cooperatives and associations in rural communities that were responsible for production and energy supply.

It was also the women – and children – who suffered most from domestic pollution from the direct burning of biomass for cooking foods, and from the long distances it was often necessary to travel to collect firewood in rural areas.

In light of the rights of women and their recognized role in the economy and the conscientious and efficient use of energy, their participation in the management of energy is fundamental.

Possible indicators of gender equality are: existence of policies and programs devoted to gender equality, to recognizing the role of women, and to building capacity to participate in decision-making processes related to projects; improvement in domestic air quality; reduction in working hours for household tasked because of access to energy.

3.7 Regulatory compliance

Project activities must respect all applicable laws and regulations from the municipality and state where they are located, and must also respect the international treaties and agreements signed by the country.

In the current Brazilian context, it is also necessary to adapt existing laws to local and regional realities in terms of production and distribution of energy by cooperatives of small independent producers and community associations. When such entities are in the area of concession of a large utility, they are currently prevented from distributing the electricity generated in small decentralized projects to neighboring communities in isolated regions not connected to the grid.

The indicators of this adaptation should be determined as a function of the project and region where it is located, but should be aimed at measuring and compliance of the project with local and national laws and international agreements, and whether diffuse rights are respected, and whether concerns and interests of minorities affected are addressed.

3.8 Financing

Cooperative-based production and the availability of financing are fundamental to the promotion of family agriculture throughout the production chain of biomass energy. It is thus important to provide resources from PRONAF, BNDES and other national funding agencies. It is also important that the sources of government financing incorporate policies and criteria that favor these types of production, such as for example the criteria of the Socio-environmental Development of Rural Family Production in Amazonia Program (PROAMBIENTE).

Indicators of sustainability for financing are: the availability of and conditions for financing; the actual demand for particular lines of credit; capacity of financing agents to serve the needs of potential clients; information about loans, etc.

4. Specific criteria and indicators for the sustainability of energy biomass

4.1.Land use

In regards to ecosystems and biodiversity, the sustainability of land use depends on the impacts on them of human activities. Such activities should avoid drastic alterations and over-exploitation of natural ecosystems and the occupation of inappropriate areas, respect previously defined instruments for management of land use, such as economic/ecological zoning, strategic environmental assessment and the ecological limits to occupation of biomes, which should be developed in a participatory and transparent manner.

The model of land occupation and use should promote and respect socio-biodiversity, thereby avoiding a model of territorial specialization in the service of

urban-industrial societies. This is the case for the large-scale monocultures, which imply significant environmental impacts and energy inefficiency because of the need for long-distance transport of both workers and the commodities produced and distributed through these artificial geographic spaces. According to Lachefski (2005):

> "*From the geographic point of view, those land use systems which are* ***decentralized*** *and* ***diversified****, with a lower demographic density, can be considered as more sustainable than centralized and specialized systems which contribute to concentration of population in urban centers, and creation of areas destined for specific production processes required for their functioning"*[7] .

Possible indicators of sustainability of land use include decentralization and diversification of production systems in the area or region; size of continuous areas of monocultures; distance from energy source to centers of consumption; distance traveled and time spent by workers to the project site; time available for workers to carry out subsistent farming activities, etc.

4.2 Origin of biomass; residues are more sustainable

The production of biomass for energy implies the use of large areas, which linked to current monoculture practices, generates significant environmental impacts on biodiversity and modes of production. Thus the use of plant residues for production of biomass for generation of electricity, heat and biofuels, whether from sugarcane bagasse, rice husks and crop wastes, forestry activities and production of vegetable oils, etc., are among the best ways to sustainably produce energy, as long as they don't prevent other important uses of agricultural wastes, such as soil conservation, for example. Methane recovery from the decomposition of urban wastes (in sanitary landfills) or agricultural wastes (swine and poultry manure, for example) for energy production can also be a sustainable alternative, depending on the previous type of management of these wastes. Burning – incineration – of urban and industrial wastes is not acceptable, because such processes produce a range of polluting emissions that are highly hazardous to human health and the environment, and whose adoption implies less sustainable and socially just decisions in comparison with other alternatives for management solid wastes.

Despite the above statement, it was accepted that "*forest resources and the areas occupied by them should be managed to supply the social, economic, ecological, cultural and spiritual needs of present and future generations"*, as stated in the document *Principles & Criteria*, of the Forestry Stewardship Council (FSC). In the case of forests, as in non-forestry agricultural practices, global society accepts and promotes the use of crops as a legitimate form of production of food, energy and other goods. It is thus necessary to create criteria and indicators of sustainability for sources of biomass used for production of energy which do not involve plant residues.

Thus, certain criteria developed by FSC could be adapted, after a detailed and in depth discussion yet to occur, for the purpose of analyzing the sustainability of systems of energy production from biomass.

It should be noted that the FSC is the target of criticism by many social movements for serving as a vehicle for increasing the acceptance of large scale monocultures, with all their well-known environmental and social problems. Also for this reason, in 2004 a process started to review Principle 10 of the FSC, which deals with the issue of plantations, and whose current guidelines lack clarity and leave room for different interpretations. In Brazil, for example, the process of certification of plantations has been carried out within a philosophy of environmental adequacion, promoting plantations without the ability to avoid the range of problems plaguing management systems based on artificial monocultures.

4.2.1 Objectives of "energy plantations"

The FSC criteria presented below are being reviewed by the FSC itself, and should be treated with caution. They do not have the consensual support of the Energy Working group. Like the other criteria presented here, they must always be considered as a whole, rather than in isolation, and must incorporate the principles mentioned above.

The management objectives of the plantation, including natural forest conservation and restoration objectives, shall be explicitly stated in the management plan, and clearly demonstrated in the implementation of the plan.

Thus it is recommended that the design and layout of plantations should promote the protection, restoration and conservation of natural forests, and not increase pressures on natural forests. Wildlife corridors, streamside zones and a mosaic of stands of different ages and rotation periods, shall be used in the layout of the plantation, consistent with the scale of the operation. The scale and layout of plantation blocks shall be consistent with the patterns of forest stands found within

[1] Lachefsi, K. 2005. O comércio de carbono, as plantações de eucalipto e a sustentabilidade das políticas públicas – uma análise geográfica. In: Zhouri, Lachefski and Pereira, 2005. A insustentável leveza da política ambiental. Belo Horizonte, Ed.Autêntica, 2005, p.245-285

the natural landscape.

In the case of energy plantations, diversity in the composition of plantations is preferred, so as to enhance economic, ecological and social stability. Such diversity may include the size and spatial distribution of management units within the landscape, number and genetic composition of species, age classes and structures.

The selection of species for planting shall be based on their overall suitability for the site and their appropriateness to the management objectives. In order to enhance the conservation of biological diversity, native species are preferred over exotic species in the establishment of plantations and the restoration of degraded ecosystems. Exotic species, which shall be used only when their performance is greater than that of native species, shall be carefully monitored to detect unusual mortality, disease, or insect outbreaks and adverse ecological impacts.

A proportion of the overall forest management area, appropriate to the scale of the plantation and to be determined in regional standards, shall be managed so as to restore the site to a natural forest cover.

Measures shall be taken to maintain or improve soil structure, fertility, and biological activity. The techniques and rate of harvesting, road and trail construction and maintenance, and the choice of species shall not result in long term soil degradation or adverse impacts on water quality, quantity or substantial deviation from stream course drainage patterns.

Measures shall be taken to prevent and minimize outbreaks of pests, diseases, fire and invasive plant introductions. Integrated pest management shall form an essential part of the management plan, with primary reliance on prevention and biological control methods rather than chemical pesticides and fertilizers.

Plantation management should make every effort to move away from chemical pesticides and fertilizers, including their use in nurseries.

Appropriate to the scale and diversity of the operation, monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts, (e.g. natural regeneration, effects on water resources and soil fertility, and impacts on local welfare and social well-being).

No species should be planted on a large scale until local trials and/or experience have shown that they are ecologically well-adapted to the site, are not invasive, and do not have significant negative ecological impacts on other ecosystems.

Special attention will be paid to social issues of land acquisition for plantations, especially the protection of local rights of ownership, use or access.

Possible indicators of sustainability of the origin of biomass are the role of plant residues as energy resources; the origin of residues used; their form of production; certification of origin of biomass; the fraction of the area of production covered with the original forest; the fraction of original biome restored; and the adaptation or minimization of the use of fertilizers and pesticides.

4.3 Environmental management

The assessment of direct environmental impacts of the activity is essential to the assessment of sustainability and must be carried out in regards to:

- **Water:** Absolute and relative consumption; Reuse (consumption/unit produced); Discharge of effluents and infiltration; Monitoring of contamination by fertilizers, herbicides and insecticides; Turbidity; Eutrophication; Suspended solid particles; environmental suitability of technology used to extract water; use of best available irrigation practices; groundwater depletion; restoration of groundwater; etc.

- **Air**: Local and Regional pollutant emissions; Emissions of greenhouse gases; Sound pollution; Odor; etc.

- **Soil:** Effluent treatment; Solid wastes; Erosion; Compaction; Contamination; Salination; etc.

- **Biodiversity and Ecosystems:** Compatibility with native biomes; Monitoring of populations of endemic species – flora and fauna – which are adapting or threatened with local or total extinction; Connections between remaining forest fragments; Creation of buffer zones; Alteration of reproduction and growth period; Precipitation or delay in period of migration of birds and/or insects; Geographic distribution of populations; Alterations in reproduction cycles of species; Changes in rates of infection of host species and increase in vectors; etc.

Possible indicators of sustainability of environmental management could be: water consumption; amount of atmospheric pollution emissions; the amount of residues disposed of on the

land; loss of topsoil; soil compaction and erosion; measures of impact on biodiversity; net CO_2 emissions.

4.4 Organization of production and labour relations

The experience of the Brazilian alcohol program (PROALCOOL) demonstrated that the organization of production of biofuels can contribute to concentration of wealth and social exclusion. To ensure the sustainability of energy production from biomass, new initiatives must incorporate and promote family agriculture throughout the production chain, since to achieve the objective of social inclusion, family agriculture should not be merely providers of raw material, but rather participate in higher value added processes and take over more of the chain of production, which requires capacity building and creation of other basic conditions to enable them to compete with the large-scale producers.

Priority must not be given to agribusiness, where production usually involves large-scale monocultures, extensive use of pesticides and genetically modified species.

The inputs to production, such as ethanol for biodiesel, should wherever possible be produced in the region.

In cases where production is organized around contracts involving integrated production systems (*contratos de integração*), these should be created in a democratic and transparent manner, with the participation of unions and with safeguards that offer sufficient protection to the family farmers being contracted, along with requiring that certified seeds be supplied by the contracting company.

All employers must be required to comply with labour legislation and the inalienable right to association and to form labour unions and associations of family farmers.

All activities in the chain of production must seek to incorporate all possible projects that generate resources for the communities, such as in production of biodiesel, edible vegetable oil, the use of the cake and fibers of coconut and babaçu.

Possible indicators of the sustainability of organization of production are: fraction of the income from the biofuel production chain that goes to family farmers; level of satisfaction with existing contracts; quantity of products produced by family farms over the production chain.

4.5 Food security

The expansion of production of oil-bearing plants for biodiesel production, and other crops for production of ethanol and energy plantations, must not be allowed to lead to an extreme specialization of territories. Thus the emergence of regions totally devoted to the production of biofuels, with a consequent reduction of local food production which could contribute to regional increases in food costs and relative scarcity, must be avoided. Practices that contribute to sustainability must prevent this eventuality by incorporating specific targets for food security that promote, for example farming practices that combine production of oil-bearing plants and other bio-fuels with subsistence food crops.

Possible indicators of food security are: size of properties and diversity of crops produced; relation between biofuel and food species; and the relation between on-farm and community consumption of the crops produced and external use.

4.6 Technology

The aspects of scientific development and the transfer and appropriation of technologies by local communities must be present, and the technologies adopted must be appropriate to local realities.

The employment of appropriate technologies implies the involvement of communities, decentralization of production of energy resources, and contribution of the project to energy independence and technological improvement.

Technology transfer should be not only vertical, but also horizontal, both between communities and between developing countries with similar ecological and geographical characteristics and regional realities.

The development of technologies should be based on institutional involvement in carrying out Research and Development and ensure the replicability of its applications and experiences, above all enabling and expanding South-South technological transfers.

In terms of energy efficiency, the best use of combustion of biomass and biofuels should be pursued, for example through combined cycle technology or replacement of low efficiency equipment. The carbon balance must be negative, or at least near zero, in the entire project life cycle.

The indicators to be considered include application of clean technologies; technological innovation; capacity of reproduction of technology used; origin of equipment; existence of royalties and technology licenses; need for international technical support; change in the use of sustainable energy; and cogeneration.

4.7 Resources for R&D

Investments in R&D and education must be used to overcome technological dependency.

Possible indicators are: amount of resources, institutions and researchers involved.

4.8 Use and quality of bioenergy

Because of its potential impact on traditional populations and ecosystems, biomass energy should be used for purposes that also contribute to the sustainability of the country. It is important that this energy source supply high efficiency end uses which contribute to expansion of the domestic market and total national family incomes. Energy intensive projects, for example, should be excluded and more efficient forms of transport should be privileged. Possible indicators for efficient end uses are rates of reduction of consumption per unit of output; capacity for reduction, reuse and recycling of inputs in the final activities for which the energy is destined; inclusion of demand management in the project planning horizon.

5. Summary table of sustainability criteria and indicators for biomass energy

The table below synthesizes both the general criteria – basic criteria applicable to any type of initiative - and specific criteria - for projects that involve the use of bioenergy – described above.

It also presents, for each criteria considered, the ideal situation and recommendations for full compliance, as well as factors involved in achieving this. *Undesirable* refer to situations that cannot be considered to be in accordance with the proposed sustainability criteria.

Criteria	Desirable	Prerequisites	Undesirable	Indicators
Social accountability	local acceptance of who and what the energy is for; electrical generation for isolated communities	information and capacity-building	energy for internal use by energy-intensive industries	participation of local population and national socio-environmental organizations in project design
Participation in decision-making	both beneficiaries and affected populations have influence in decision-making	information and training, political forums for participation with real influence over decisions	public consultations with no commitment to consider demands and with no influence on decisions	number, sites, nature and types of consultations, form of publicity, access to information, language and accessibility of material used
Type of management	Cooperatives, community associations	training for management of cooperatives, financing (PRONAF / BNDES)	traditional agribusiness, contracts involving integrated production systems that create unfair working and business conditions	organizational structure and forms of decision-making, number of participants/decision-makers, involvement of organizations representing local workers, participation of women
Job creation and income generation	family agriculture; jobs for local population, creation of conditions for youth employment	training for creation of cooperatives; awareness and training of families with technical and political information	capital intensive agribusiness, concentration of income and land ownership, local population involved only in low-skilled jobs	number of jobs per unit of energy (production chain, implementation and operation), profit sharing, generation of new local opportunities and sources of income, relation between local jobs before and after the project, indexes of increase in acquisitive power of the local population
Social inclusion	capacity-building and training in technology, involvement of community surrounding the project; social support to the families involved; leads to improved quality of life of women and youth	Sharing of project benefits with local population	absence of community involvement; disruption of traditional patterns of subsistence and culture	number of families previously without access to energy who benefit from the project; measures of quality and compliance with accepted standards of the involuntary resettlements, when necessary and accepted; impact on the quality of life of the communities; social programs, especially for health and education; epidemiological assessment and monitoring; contribution to access to services and infra-structure on the part of local populations to education, energy, garbage and sewage services, etc.; contribution to adult literacy and environmental education; reduction of violence and vulnerability of women and youth

Gender equality	recognition of women and key actors in all stages of decision-making processes	Education		improvement in indoor air quality, reduction of hours of women's work on domestic tasks; existence of programs and policies for women and youth
Regulatory compliance	compliance with municipal, state and national legislation as well as international agreements	Transparency		published audits
Financing	rural credit for family farming	financing through PRONAF and BNDES; access to land	financing for intensive agribusiness	programs and lines of credit; conditions for government financing
Land use	comply with economic/ecological zoning (EEZ); region classified as suitable by strategic environmental assessment; defined limits for occupation of biomes; diversification and decentralization of economic activities	Existence of EEZ and Strategic Environmental Assessment for the region, watershed or biome; definition of ecological limits on economic activities in biomes; protection of natural areas	occupation of inappropriate areas; overexploitation of ecosystems; extreme territorial specialization	decentralization and diversification of production systems in an area / region; size of continuous areas of monocultures; distance from energy source to consumer; distance traveled and time spent by workers to the project site; time necessary off their land for workers to manage subsistent crops
Origin of biomass	use of plant residues; products of agro-ecology and family agriculture		monocultures; transgenics; alteration of natural biomes	percentage of residues out of total biomass used in project
Environmental management	Use of best available practices; diversity of crops; agroforestry systems; agroecology, permaculture; minimization or elimination of pesticide use; reduction of soil loss	training of producers and high capacity of extension personnel and support to rural workers	green deserts; soil degradation and loss; environmental contamination; forms of production using extremely dangerous and persistent pesticides	monoculture area, soil loss, atmospheric emissions and effluents into water bodies
Organization of production / labour relations	cooperatives; family agriculture		contracts involving integrated production systems	sharing of profits from biofuels production chain by family farmers; level of satisfaction with existing contracts
Food security	crop diversity, agroforestry and/or companion planting		monoculture production zones	
Technology	decentralized generation and production; technology appropriation by local population; new technologies capable of reducing pressure of energy production on ecosystems; horizontal transfer (between communities) of technologies and knowledge; contribution to diversification of energy matrix			Relation between local workers and outsiders involved in project maintenance; application of clean technologies; technological innovation; capacity of reproduction of technology used; origin of equipment; existence of royalties and technology licenses; need for international technical support; change in the use of sustainable energy, cogeneration
Use of bioenergy	creating more efficient transport systems; promotion of energy efficiency			rates of reduction of consumption; increased end use conservation; capacity for reduction, reuse and recycling of inputs in the final activities for which the energy is destined; inclusion of demand management in the project planning horizon.



Design: Daniele Sallaberry