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GLOBAL BIOENERGY PARTNERSHIP

WORKING TOGETHER FOR SUSTAINABLE DEVELOPMENT

Rapid Implementation Framework for the GBEP Sustainability Indicators for Bioenergy: Handbook

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1 INTRODUCTION

AIM **This Chapter sets the background for the RIF, providing information on resource requirements, stakeholder engagement and the steps in the process.**

1.1 Background

In December 2011, the Global Bioenergy Partnership (GBEP) agreed upon a set of 24 indicators for the assessment and monitoring of bioenergy sustainability. Each of the 24 indicators includes a short description and a multi-page methodology sheet that outlines the approach for collecting and analysing data, highlights data limitations and provides additional references to other well-documented processes.

Since their adoption, the GBEP indicators have been implemented in fourteen countries, spanning four continents. On the basis of the lessons learned from the implementation of the indicators, an Implementation Guide was published in 2020. This document provides methodological guidance for each of the 24 indicators, addressing a number of related practical issues as well.

The measurement of GBEP sustainability indicators for bioenergy may require significant resources (both human and financial) and tends to be data- and capacity-intensive. The publication of the Implementation Guide represents an important step in aiding countries with the implementation of these indicators. However, to advance their uptake, it is important to further facilitate a less resource-intensive measurement of the GBEP indicators, especially in case of limited data and capacity.

1.2 Scope and objectives.

This Rapid Implementation Framework (RIF) aims to complement the Implementation Guide, by supporting and expediting the operationalization of selected working packages included in it. In particular, the RIF allows users to conduct an evidence-based prioritization of the GBEP indicators. This means that within six months, it should be possible to carry out a rapid measurement of the critical GBEP indicators and obtain a preliminary indication of likely impacts on sustainability from the most relevant bioenergy pathways in the country/region considered.

1.3 Target users, resource requirements and stakeholder engagement.

The RIF is intended mainly for practitioners interested in conducting a rapid assessment of the sustainability of the bioenergy sector and/or specific bioenergy pathways in their country or region, using the GBEP indicators. The results of this six-month process provide a preliminary indication of likely impacts on sustainability, and information on where more in-depth assessment is required due to large, critical and/or unmeasurable impacts. For a more thorough assessment of these impacts, the full methodologies described in the indicator report should be used.

The RIF can be used flexibly depending on country context. The intention is that the RIF is conducted as a (series of) multi-stakeholder meetings. However, the questionnaires provided in this handbook can be responded to in a group format or individually, with the results being later compiled.

As explained in the Implementation Guide, among the overarching practices for an effective implementation of the GBEP indicators, users should seek to encourage the proactive **engagement of all relevant stakeholders** including government agencies, private sector organizations, academic/research institutions and civil society organizations. This is particularly important in the context of a rapid implementation of the GBEP indicators. The questions included under the various steps that comprize the RIF should be addressed to selected producer associations (including biomass suppliers) and to a multidisciplinary group of experts with an in-depth knowledge of:

- The national/local context, particularly in terms of environmental and socio-economic characteristics/conditions and related vulnerabilities;
- The domestic agricultural and forestry sectors and related markets; and
- The domestic bioenergy sector and related technologies, logistics and policies.

Ideally, feedback should be sought as well from a sample of end-users, including both households and businesses, especially in relation to off-grid power applications and small-scale cooking and heating systems. In order to answer the questions, information and data available in national and international databases may be used, combined with expert judgement. In some cases, ballpark estimates based on experience will be necessary. Sources of information should be clearly stated.

The table below – an excerpt from the Implementation Guide – includes the list of public, private and multilateral stakeholders to be engaged.

Public	Private	Multilateral

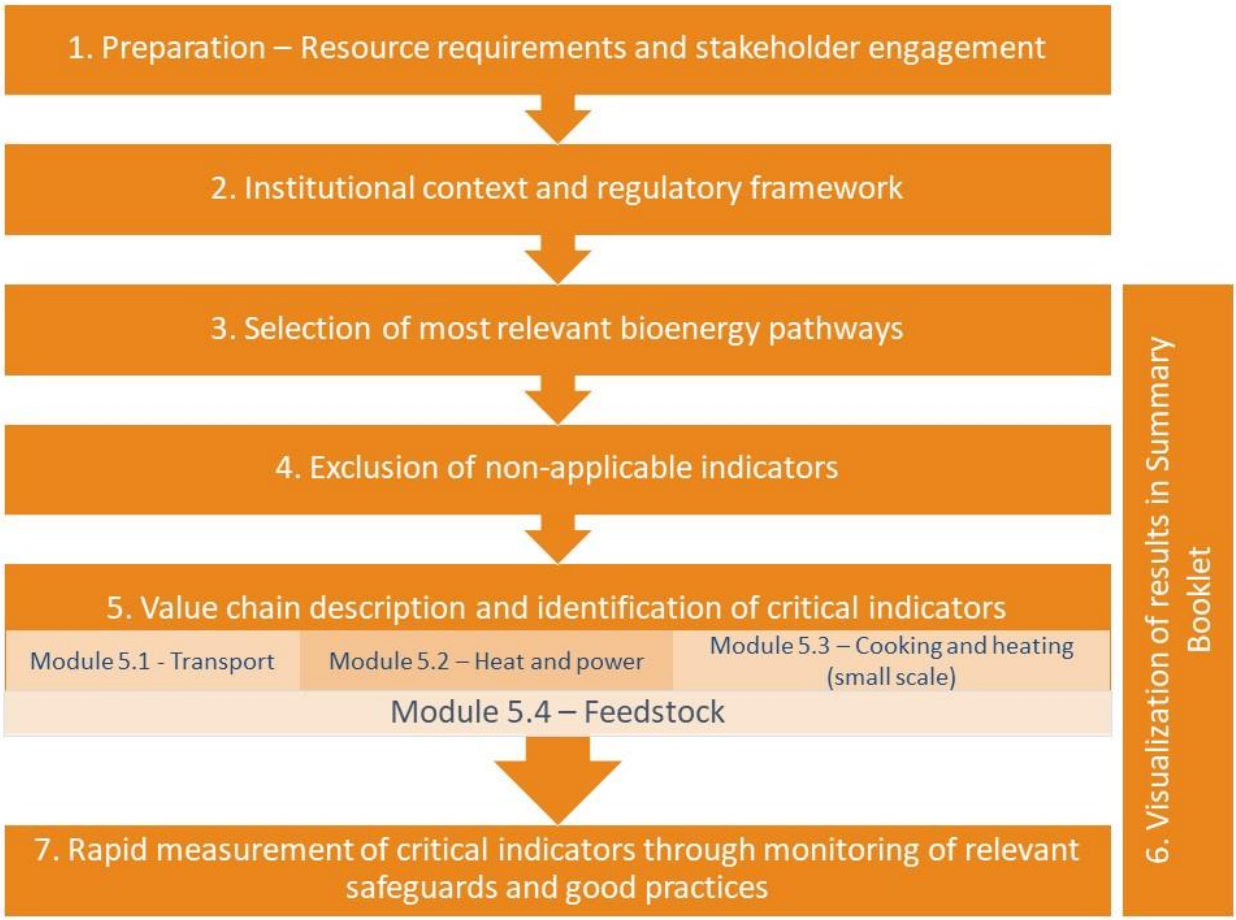
• Ministries:
  • Agriculture/Rural development
  • Industry/Commerce
  • Energy
  • Labour
  • Trade
  • Planning
  • Environment/Natural Resources
  • Social affairs
• National Universities and research institutes
	• Producer Associations
	• Chambers
	• Research and Development Institutions
	• Cooperatives
	• NGOs
	• Bioenergy Companies
	• Finance institutions
		• International Institutions
		• Multinational research centres

1.4 Rapid Implementation steps.

The Rapid Implementation Framework provides relevant guidance and materials to be followed for the rapid implementation of the indicators:

- **Description of Institutional Context and Regulatory Framework** [Chapter 2].
- **Selection of Most Relevant Bioenergy Pathways** [Chapter 3].
- **Exclusion of Non-Applicable GBEP Indicators** [Chapter 4].
- **Value Chain Description and Identification of Critical GBEP Indicators** [Chapter 5].
- **Visualization of Results of Prioritization of GBEP indicators** [Chapter 6].
- **Monitoring of safeguards and good practices relevant for critical GBEP indicators** [Chapter 7].

The flowchart below shows gives a visual overview of the steps involved in the rapid implementation.



Chapter 2 (Description of Institutional Context and Regulatory Framework) comprises a questionnaire addressing the following issues:

- Policy-making process;
- Bioenergy targets/mandates and incentives; and
- Drivers/objectives and sustainability requirements of bioenergy policies.

Based on the latter, a preliminary list of critical GBEP indicators is generated, which are the minimum that would be required to monitor the identified sustainability priorities of the bioenergy policies. As explained below, additional critical GBEP indicators are further identified in Chapter 5 (Value Chain Description and Identification of Critical GBEP Indicators).

In **Chapter 3**, guidance is offered on the selection of the most relevant bioenergy pathways for analysis, and a few possible selection criteria are suggested.

Once the most relevant bioenergy pathways have been identified, the next stage of the RIF aims to identify the critical indicators to measure and monitor based on the sustainability risks of the particular pathway(s). As a first step, in **Chapter 4**, a list of non-applicable GBEP indicators and sub-indicators is provided, depending on the selected bioenergy pathway(s).

Chapter 5 includes a questionnaire that aims to help users:

- generate a description of the value chains associated with the selected bioenergy pathway(s); and
- identify critical GBEP indicators, based on the main characteristics of such value chain(s) and likely impacts on sustainability.

This Chapter consists of four modules, which should be approached as follows:

Compulsory (i.e. relevant to all bioenergy pathways):	**To be filled in depending on the selected bioenergy pathway(s) and end uses:**
Module 5.4 – Feedstock production and harvest	**Module 5.1** – Transport **Module 5.2** – Heat and Power **Module 5.3** – Cooking and heating (small-scale)

The questions in this Chapter are grouped into different categories, depending on:

- the origin of the biofuel;
- the type(s) and origin of the feedstock used; and
- the types of fuels and technologies that were displaced, if any.

Based on the answers to these questions and on the environmental and socio-economic characteristics/conditions and related vulnerabilities in the country/area considered, a list of critical GBEP indicators (in addition to those already identified in Chapter 2) is generated.

In parallel with this process, the identified critical GBEP indicators from both Chapter 2 and Chapter 5 should be included in the supplementary **Summary Booklet** available in **Chapter 6** (Visualization of Results of Prioritization of GBEP indicators). There, a table is provided where each factor that contributed to the selection of the critical indicators for the bioenergy pathway can be noted for future ease of reference.

Finally, **Chapter 7** aims to support the rapid measurement of the critical GBEP indicators. In particular, guidance is provided on the monitoring of the level (and quality) of implementation of relevant safeguards and good practices that can mitigate risks and increase benefits in relation to the sustainability dimensions addressed by the GBEP indicators. Please see Box 1 for a more detailed discussion on this.

Box 1 – Safeguards and good practices for sustainable bioenergy: the Climate-Smart Agriculture approach

The monitoring of the level of uptake – and its change over time – of ***climate-smart agriculture (CSA) practices***, along with other safeguards and good practices, can provide a preliminary indication of the sustainability of biomass supply.

Some of the main objectives of CSA are to sustainably increase agricultural productivity and to reduce GHG emissions, whilst adapting and building resilience to climate change. These are also objectives that are important for the production of feedstock for sustainable bioenergy production. This approach is therefore beneficial to mainstream into bioenergy systems. There are two cases where this approach could be applied:

- ***Sustainable production of dedicated biomass***, for example, in the adoption of practices that improve the sustainability of production such as conservation agriculture, intercropping, crop rotation, integrated pest management, etc.; and
- ***Improving the sustainability of food systems with the use of residues and/or wastes***, from either production and processing of agricultural products and residues, or from food loss and waste at the end of the value chain. Examples of approaches could include the circular use of wastewater, alternative uses of crop residues to avoid burning, and circular use of nutrients and carbon stock.

The CSA approach also includes the integration of bioenergy into farming systems to improve their sustainability. In fact, when bioenergy is integrated into farming systems it can enhance their efficiency, provide additional source of income through product diversification, increase access to modern energy and reduce impacts of agriculture on climate change. Furthermore, the bioenergy by-products can also be used as an additional source of energy or returned to the soil to recycle nutrients and also capture and store carbon. This means that the capacity of the farming system to adapt to and mitigate climate change is improved. So the use of bioenergy in farming systems can ultimately increase the sustainability of agri-food value chains, and improve livelihoods and food security.

A more detailed list of CSA practices and a discussion of their impacts on sustainability can be found in Chapter 7.

WHERE TO?

Finished this Chapter?

Go to Chapter 2 “Description of institutional context and regulatory framework”.

2 DESCRIPTION OF INSTITUTIONAL CONTEXT AND REGULATORY FRAMEWORK

AIM **This Chapter consists of a questionnaire focused on the policy, institutional context and regulatory framework. The questions should be addressed to relevant experts and decision-makers at national and sub-national levels.**

2.1 Policy-making process.

This section includes four questions addressing the policy-making process. Even though these questions are not directly linked to the subsequent steps of the Rapid Implementation Framework, they provide an indication of the extent to which key good practices were followed when formulating the bioenergy policy under consideration. Adhering to these practices is a necessary but not sufficient condition to ensure a sustainable development of the bioenergy sector.

- **Was an assessment of the sustainable bioenergy potential in the country carried out prior to the adoption of the bioenergy targets?** ***Briefly describe the methodology used, and the scope and level of detail of such assessment.***

- **Below is a list of relevant institutions for bioenergy policy.** ***Please mark which of these institutions were included in the decision-making process that led to the adoption of the national bioenergy policy. Please indicate as well the level of alignment of the bioenergy policy with the sectoral policies that these institutions are responsible for.***

MINISTRIES/ AGENCIES WITH COMPETENCE OVER:	INCLUDED IN DECISION-MAKING?	ALIGNMENT WITH SECTORAL POLICIES			NAME OF AGENCY & ADDITIONAL INFORMATION
		Absent / slight	Partial	Full	
Bioeconomy	☐	☐	☐	☐	
Agriculture	☐	☐	☐	☐	
Forestry	☐	☐	☐	☐	
Livestock	☐	☐	☐	☐	
Energy	☐	☐	☐	☐	
Industry/Commerce	☐	☐	☐	☐	
Infrastructure	☐	☐	☐	☐	
Transport	☐	☐	☐	☐	
Employment/Labor	☐	☐	☐	☐	
(Rural) development	☐	☐	☐	☐	
Food security	☐	☐	☐	☐	
Gender	☐	☐	☐	☐	
Health	☐	☐	☐	☐	
Land / land-use planning	☐	☐	☐	☐	
Climate change	☐	☐	☐	☐	
Air quality	☐	☐	☐	☐	
Biodiversity	☐	☐	☐	☐	
Water	☐	☐	☐	☐	
Other natural resources / environment (please specify)	☐	☐	☐	☐	
Other (please specify)	☐	☐	☐	☐	

- **Below is a list of relevant stakeholder groups for bioenergy policy (in addition to the ministries/agencies listed above).** ***Please mark which of these stakeholder groups were adequately consulted with during the decision-making process that led to the adoption of the national bioenergy policy and related targets. For each stakeholder group, please indicate the level of support expressed for the bioenergy policy and targets.***

STAKEHOLDER GROUPS	Consulted?	LEVEL OF SUPPORT			NAME OF GROUP AND ADDITIONAL INFORMATION
		Low	Moderate	High	
Biomass producers/suppliers	☐	☐	☐	☐	
Biofuel industries	☐	☐	☐	☐	
Workers	☐	☐	☐	☐	
Investors	☐	☐	☐	☐	
Indigenous groups	☐	☐	☐	☐	
Academia / research	☐	☐	☐	☐	
Environmental NGOs	☐	☐	☐	☐	
Development/Social NGOs	☐	☐	☐	☐	
Other (please specify)	☐	☐	☐	☐	

- **Is the bioenergy policy aligned with relevant international/national commitments?** ***Please indicate the level of alignment in the table below.***

NATIONAL/REGIONAL/INTERNATIONAL COMMITMENTS	ALIGNMENT			ADDITIONAL INFORMATION
	Absent / slight	Partial	Full	
Nationally Determined Contribution (NDC)	☐	☐	☐	
Nationally Appropriate Mitigation Actions (NAMA)	☐	☐	☐	
National Adaptation Plan (NAP)	☐	☐	☐	
Sustainable Development Goals (SDGs) implementation	☐	☐	☐	
Convention on Biological Diversity (CBD) and its Protocols	☐	☐	☐	
Convention to Combat Desertification (UNCCD)	☐	☐	☐	
Ramsar Convention on Wetlands	☐	☐	☐	
Other (please specify)	☐	☐	☐	

2.2 Bioenergy targets/mandates and incentives.

The table below aims to depict an overview of the bioenergy targets and mandates in place and of related support mechanisms. These questions should be addressed to staff members dealing with policies within relevant ministries; and to policy experts.

***Please provide the information for each bioenergy pathway listed below*:**

	Target (MJ / share (%) of final energy consumption, by year)[1]	**Nature of target**[2]	**Mechanisms to ensure compliance** (e.g. penalties)	**Tax incentives**[3]	**Price support mechanisms**	**Support for RD&D**[4]	**Other support mechanisms** (please specify):
TRANSPORT							
– Road transport							
– Aviation							
– Maritime							

[1] Volume or share of biofuels/bioenergy foreseen by the target (and related timeline) for the various sub-sectors.

[2] (voluntary/aspirational vs. mandatory/binding)

[3] (e.g., excise differentials between fossil fuels and biofuels):

[4] (e.g., funds for research/pilot/demonstration projects):

– Total							
HEAT AND POWER (LARGE-SCALE / ON-GRID)							
– Heat							
– Power							
RURAL ELECTRIFICATION (SMALL-SCALE / OFF-GRID)							
HEATING AND COOKING (SMALL-SCALE)							
– Heating							

– Cooking							

2.3 Drivers/objectives and sustainability requirements of bioenergy policies.

The questions in this section deal with the sustainability drivers, objectives and requirements (if any) of the bioenergy policy under consideration. Related monitoring and enforcement mechanisms are captured as well.

For each sustainability dimension addressed by the aforementioned drivers/objectives and requirements, a table with the corresponding list of critical GBEP indicators is provided below. In order to check whether the sustainability requirements were met and evaluate progress towards the achievement of the aforementioned drivers/objectives, the related critical GBEP indicators should be measured.

Critical indicators identified in this step should be included in the dedicated table in the Summary Booklet in Chapter 6, providing information on the related bioenergy policy and its sustainability dimension(s).

***Please provide the information listed below*:**

- **Sustainability drivers/objectives and requirements (if any) of the bioenergy policy shall be identified**. The critical GBEP indicators associated with the sustainability dimensions addressed by such drivers/objectives/requirements are listed below.

Sustainability dimensions	**Driver/objective of policy? Y/N**	**Critical GBEP indicators**
Reduced GHG emissions (e.g., compared to fossil fuels or traditional biomass use)		**1. Lifecycle GHG emissions**
Improved air quality		**4. Emissions of non-GHG air pollutants, including air toxics**
Avoided land-use change		**8. Land use and land-use change related to bioenergy feedstock production**
Avoided conversion of areas of high biodiversity value or critical ecosystems		**7. Biological diversity in the landscape[5]**
Rehabilitation of marginal, underutilized and contaminated lands		**2. Soil quality**
Increased agricultural productivity		**17. Productivity**
Improved land management		**7. Biological diversity in the landscape[6]; 5. Water use and**

[5] Specifically sub-indicator 7.1: "Area and percentage of nationally recognized areas of high biodiversity value or critical ecosystems converted to bioenergy production".

[6] Specifically sub-indicator 7.3: "Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used".

		efficiency; 2. Soil quality; 6. Water quality
Improved forest management		**3. Harvest levels of wood resources**
Improved residue/waste management		**2. Soil quality; 6. Water quality; 1. Lifecycle GHG emissions**
Industrial development		**19. Gross value added**
Income generation/diversification		**11. Change in income**
Job creation		**12. Jobs in the bioenergy sector**
Synergy (or at least avoided competition) with food security		**10. Price and supply of a national food basket**
Reduced dependence on fossil fuels		**20. Change in consumption of fossil fuels and traditional use of biomass**
Reduced dependence on traditional biomass use		**20. Change in consumption of fossil fuels and traditional use of biomass; 13. Change in unpaid time spent by women and children collecting biomass**
Reduced exposure to indoor air pollution		**15. Change in mortality and burden of disease attributable to indoor smoke**
Increased access to modern energy services		**14. Bioenergy used to expand access to modern energy services**
Increased diversity and security of energy supply		**22. Energy diversity**

- **Has a system/mechanism** (e.g., certification) **been devised to demonstrate producers' compliance with the sustainability requirements**?
  Briefly explain how such system/mechanism works.

- **Are relevant environmental and socio-economic impacts of biofuel production and use monitored**, so as to assess the contribution to the aforementioned drivers/objectives and detect any unintended impacts on sustainability, with a view to adjust the policy/targets accordingly?

Briefly explain how environmental and socio-economic impacts get monitored.

WHERE TO?

Finished this Chapter?

Add the identified critical indicators into the Summary Booklet in **Chapter 6**, adding a note as to the reason for criticality.

Then, go to **Chapter 3** “Selection of most relevant bioenergy pathways”.

3 SELECTION OF THE MOST RELEVANT BIOENERGY PATHWAYS

AIM **Selection of the most relevant existing bioenergy pathways in the country to be analyzed during the rapid implementation.**

In order to enable a rapid implementation of the GBEP indicators, part of the prioritization process concerns the selection of the most relevant existing bioenergy pathways in the country. This selection should be conducted in consultation with all relevant ministries/agencies and stakeholder groups described in the previous chapter.

The outcome of this selection process should be included in the Summary Booklet in Chapter 6.

A few possible criteria (non-mutually exclusive) to be considered for the selection of the bioenergy pathways include:

Levels of bioenergy production and/or use

The first criterion relates to the level of production of a certain biofuel (liquid, solid or gaseous) and/or to its share of final energy consumption in the various end-use sectors, i.e.:

- Transport;
- Heat and power; and
- Cooking and heating (small scale).

In addition to current volumes and shares, consideration could be given to recent trends in them, with particular attention given to biofuels displaying high growth rates in terms of production and/or use. Bioenergy pathways currently attracting significant levels of investment, or which are deemed to have a significant growth potential, could warrant special consideration as well.

Policy relevance

Another important criterion that may inform the selection of the most relevant bioenergy pathways in a country is the policy relevance of such pathways.

If policies and targets have been put in place to actively promote bioenergy production and/or use in a certain sector, it is important to assess the effectiveness of such policies and identify the resulting

impacts on sustainability. Through the analysis of these impacts, it will be possible to determine whether the policy in question achieved its intended objectives and whether any sustainability requirement included in it was fulfilled. Unintended impacts on sustainability would be detected as well.

The policy relevance of a bioenergy pathway will be particularly high in case possible revisions to the policy framework are being explored, or if additional support measures are being considered for bioenergy production and/or use.

Perceived impacts on sustainability

A third criterion that could guide the selection of the bioenergy pathways pertains to their assumed impacts on sustainability. If, among relevant ministries/agencies and stakeholder groups, there is a perception that certain sustainability impacts of relevance to them have materialized within a bioenergy pathway, the rapid implementation of the GBEP indicators could help shed light on the nature and magnitude of such impacts.

Furthermore, as mentioned above, priority could be given to the analysis of the pathways the development of which has been promoted in order to pursue specific environmental and socio-economic objectives, such as GHG emission reduction, job creation and diversification of the energy supply.

WHERE TO?

Finished this Chapter?

Include the selected bioenergy pathways in the Summary Booklet in **Chapter 6**.

Then, go to **Chapter 4** “Exclusion of Non-Applicable GBEP Indicators”.

4 EXCLUSION OF NON-APPLICABLE GBEP INDICATORS

AIM **Exclusion of non-applicable indicators to the selected bioenergy pathways.**

Once the most relevant bioenergy pathways have been identified, the prioritization process of the GBEP indicators can begin. As a first step, depending on the selected bioenergy pathway(s), a few non-applicable indicators may be identified. As shown in the table below, only three social sustainability indicators (i.e., indicators 13, 14, 15) or specific sub-indicators under them may be deemed not relevant *a priori.* These indicators are indicated with an "X". When specific sub-indicators are not relevant, their number is included in brackets. Footnotes are included below the table, describing the specific circumstances in which selected indicators and sub-indicators are relevant.

Table 1. Non-applicable GBEP indicators and sub-indicators, by pathway

	TRANSPORT	HEAT AND POWER	HEATING AND COOKING (small scale)
1. Life-cycle GHG emissions			
2. Soil quality			
3. Harvest levels of wood resources			
4. Emissions of non-GHG air pollutants, including air toxics			
5. Water use and efficiency			
6. Water quality			
7. Biodiversity in the landscape			
8. Land use and land-use change related to bioenergy feedstock production			
9. Allocation and tenure of land for new bioenergy production			
10. Price and supply of a national food basket			
11. Change in income			
12. Jobs in the bioenergy sector			
13. Change in unpaid time spent by women and children collecting biomass	X	X	X[1]
14. Bioenergy used to expand access to modern energy services	X	X (14.1[2]; 14.2[3])	X (14.1[2])
15. Change in mortality and burden of disease attributable to indoor smoke	X	X	X[4]
16. Incidence of occupational injury, ilness and fatalities			
17. Productivity			
18. Net energy balance			
19. Gross value added			
20. Change in consumption of fossil fuels and traditional use of biomass			
21. Training and re-qualification of the workforce			
22. Energy diversity			
23. Infrastructure and logistics for distribution of bioenergy			
24. Capacity and flexibility of use of bioenergy			

[1] Applicable only in case of displacement of traditional biomass use.

[2] Applicable only in case access to modern energy services was gained thanks to the bioenergy pathway being considered.

[3] Sub-indicator 14.2 not applicable to power (applicable only to heat).
[4] Applicable only in case modern bioenergy applications displace traditional uses of biomass for heating and/or cooking purposes in indoor open stoves or fires with no chimney or hood.

WHERE TO?

Finished this Module?

Make notes on non-applicable indicators in the Summary Booklet in **Chapter 6**, adding a note as to the reason for non-applicability.

Then, go to **Chapter 5** "Value chain description and identification of critical GBEP Indicators".

You should choose the Module that fits the chosen bioenergy pathway(s):

- Module 1: Transport
- Module 2: Heat and Power
- Module 3: Cooking and heating (small scale)

5.1 VALUE CHAIN DESCRIPTION AND IDENTIFICATION OF CRITICAL GBEP INDICATORS – TRANSPORT BIOFUELS

AIM

The questions in this chapter aim to:

- **generate a description of the transport biofuel value chain; and**
- **identify critical GBEP indicators, based on the main characteristics of the value chain and likely impacts on sustainability.**

The critical GBEP indicators emerging from this chapter should be considered as additional to those identified in Chapter 2 (Description of Institutional Context and Regulatory Framework) based on the sustainability requirements and drivers/objectives of the bioenergy policy. They should be included in the Summary Booklet in Chapter 6, along with comments on the relevant sustainability factors that led to their selection.

The questions in this chapter should be addressed to relevant sectoral experts and selected producer associations. In order to answer them, information and data available in national and international databases may be used, combined with expert judgement. In some cases, ballpark estimates based on experience will be necessary.

The questions are grouped into different sections, depending on:

- the origin of the biofuel; and
- the type of feedstock used.

Questions addressing the way the additional demand for each biofuel feedstock was met are included in the feedstock questionnaire (Module 5.4).

Before addressing these issues, a few general, introductory questions are included below, with the aim to set the timeframe of the analysis and collect basic data on the level of transport biofuel production, consumption and trade. (All mentions of biofuels below refer to transport biofuels.)

Please provide the information below in relation to biofuels for transport.

	Answers:
Year in which the bioenergy policy/programme and the related targets (if any) were adopted (to be referred to as baseline year[7]):	
Year of analysis (to be referred to as reference year):	
Biofuel production, consumption and trade volumes (in MJ/year). ***Please provide the total volumes of biofuel produced, consumed and traded in the reference year, for each biofuel produced and consumed in the country.***	
- Total biofuel production: MJ/year	
- Total biofuel consumption: MJ/year	
- Total biofuel exported: MJ/year	
- Total biofuel imported: MJ/year	

[7] If no policy/programme is in place to support the adoption of modern bioenergy technologies for heating and cooking, the year in which such technologies started being introduced in the country could be used as baseline.

5.1.1 Imported biofuels.

	CRITICAL GBEP INDICATORS:	POTENTIALLY CRITICAL GBEP INDICATORS (depending on the requirements and drivers/objectives of the biofuel policy):
Imported biofuels are unlikely to present significant risks to sustainability at national level. The net trade balance of the country, which is not measured by any specific GBEP indicator, will be affected though.	**Indicator 1 (Lifecycle GHG emissions[8]).**	**Indicator 4 (Emissions of non-GHG air pollutants, including air toxics[9]);** **Indicator 20 (Change in consumption of fossil fuels and traditional use of biomass);** **Indicator 22 (Energy diversity);** **Indicator 23 (Infrastructure and logistics for distribution of bioenergy[10]);** **Indicator 24 (Capacity and flexibility of use of bioenergy).**

WHERE TO?

Imported biofuel?
Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

Go to **Section 5.1.3** in this module to identify critical GBEP indicators (if any) in relation to biofuel distribution.

Domestically produced biofuels?
Continue in this Module to **Section 5.1.2**

[8] Especially in case the domestic policy foresees specific GHG emission saving thresholds.
[9] From biofuel use.
[10] This indicator will be critical especially in case the distribution of biofuels is highly concentrated along a few routes, increasing the risk of supply disruptions.

5.1.2 Domestically produced biofuels.

Please provide the information below for each transport biofuel produced in the country.

	Answers
• **Biofuel feedstocks:**	
○ **Crops/trees/grasses**: [repeat for each type of crop/tree/grass used as bioenergy feedstock]**.**	
○ **Crop/livestock/forest residues**: [repeat for each type of residue used as bioenergy feedstock].	
○ **Processing residues**: [repeat for each type of residue used as bioenergy feedstock].	
○ **Waste**: [repeat for each type of waste used as bioenergy feedstock].	
• **Main feedstock production/harvesting/collection areas** [repeat for each feedstock]:	
• **Main sites/plants for the pretreatment of biomass:**	
• **Main biofuel production sites:**	
• **Main technologies used for/in:**	
○ Biomass preprocessing/pretreatment:	
○ Biofuel production:	

WHERE TO?

Finished this section?

Go to **Module 5.4** related to feedstock production/harvesting **before** proceeding to Section 5.1.3 in this Module.

5.1.3 Feedstock Transportation and Preprocessing/Pretreatment, and Biofuel Production and Distribution.

Beside the indicators identified for the feedstock production/harvesting stage, a number of additional GBEP indicators may be critical for the other stages of the biofuel supply chain, i.e., feedstock transportation and pre-processing/pretreament, and biofuel production and distribution. A few questions are included below, in order to support the identification of critical indicators associated with these stages.

	CRITICAL GBEP INDICATORS
• **On average, does the feedstock travel over long distances before reaching the plants for the preprocessing/pretreatment of biomass and/or for the production of biofuels?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 18 (Net energy balance);** **Indicator 23 (Infrastructure and logistics for distribution of bioenergy).**
• **On average, do biofuels travel over long distances before reaching fuel terminals and wholesalers?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 18 (Net energy balance);** **Indicator 23 (Infrastructure and logistics for distribution of bioenergy).**
• **Are feedstock transportation and/or biofuel distribution concentrated along a few critical routes[11]?**	**Indicator 23 (Infrastructure and logistics for distribution of bioenergy).**

[11] As described under GBEP indicator 23 (Infrastructure and logistics for distribution of bioenergy), "critical routes are those which are subject to significant risk of disruption and which could not easily or quickly be replaced, such as pipelines, port facilities, etc., taking into account the relative volume capacity of each mode".

• **Is energy used in biomass preprocessing/pretreament and/or in biofuel production obtained from the combustion of:** ○ **Woodfuel;** ○ **Fossil fuels** (e.g., coal)**.**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 3 (Harvest levels of wood resources) (ONLY woodfuel);** **Indicator 4 (Emissions of non-GHG air pollutants, including air toxics);** **Indicator 18 (Net energy balance).**
• **Is there significant room to increase the overall efficiency of biomass preprocessing/pretreatment and/or biofuel production using best available technologies?**	**Indicator 17 (Productivity[12]);** **Indicator 18 (Net energy balance).**
• **Are the main plants for the preprocessing/pretreatment of biomass and/or for the production of biofuels located in areas with medium, high or critical levels of water stress** [as per SDG indicator 6.4.2]**?**	**Indicator 5 (Water use and efficiency).**
• **Are the main plants for the preprocessing/pretreatment of biomass and/or for the production of biofuels located within watersheds considered most vulnerable to pollution from effluents?**	**Indicator 6 (Water quality[13]).**
• **Is there freedom of association and the effective recognition of the right to collective bargaining in the transportation and manufacturing sectors?**	**Indicator 11 (Change in income)[14];** **Indicator 12 (Jobs in the bioenergy sector[15]).**
• **Are trainings and proper equipment provided to workers in plants for the preprocessing/pretreatment of biomass and/or for the production of biofuels, in order to minimize occupational health and safety risks?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities);** **Indicator 21 (Training and re-qualification of the workforce).**

[12] Specifically, sub-indicator 17.2 (Processing efficiencies by technology and feedstock).
[13] Specifically, sub-indicator 6.2 (Pollutant loadings to waterways and bodies of water attributable to bioenergy processing effluents, and expressed as a percentage of pollutant loadings from total agricultural processing effluents in the watershed).
[14] Specifically, sub-indicator 11.1 (Contribution of the following to change in income due to bioenergy production: wages paid for employment in the bioenergy sector in relation to comparable sectors).
[15] Specifically, sub-indicator 12.2 (Total number of jobs in the bioenergy sector and percentage adhering to nationally recognized labour standards consistent with the principles enumerated in the ILO Declaration on Fundamental Principles and Rights at Work, in relation to comparable sectors).

5.1.4 Domestic biofuel consumption.

Please answer the questions below for each biofuel consumed in the country.

	Answers	CRITICAL GBEP INDICATORS
• **Share of biofuels consumption in each transport sub-sector:**		
• **Road transport**: share (%) of final energy consumption.		
• **Aviation**: share (%) of final energy consumption.		
• **Maritime**: share (%) of final energy consumption.		
• **Total**: share (%) of final energy consumption.		
• **Progress towards target/mandate:**		
• **Road transport**: share (%) of target/mandate met.		
• **Aviation**: share (%) of target/mandate met.		
• **Maritime**: share (%) of target/mandate met.		
• **Total**: share (%) of target/mandate met.		
• **Progress towards blending wall:**		**Indicator 24 (capacity and flexibility of bioenergy use).**
• **Road transport**: share (%) of blending wall met.		
• **Aviation**: share (%) of blending wall met.		
• **Maritime**: share (%) of blending wall met.		
• **Total**: share (%) of blending wall met.		
• **Number of flex-fuel vehicles that can use either fossil fuel/biofuel:**		**Indicator 24 (capacity and**

• Road transport		**flexibility of bioenergy use).**

WHERE TO?

Finished this Module?

Add the identified critical indicators into the Summary Booklet in **Chapter 6**, adding a note as to the reason for criticality.

Then, go to **Chapter 7** "Rapid measurement of critical GBEP indicators through monitoring of relevant safeguards and good practices".

5.2 VALUE CHAIN DESCRIPTION AND IDENTIFICATION OF CRITICAL GBEP INDICATORS – HEAT AND POWER

AIM

The questions in this chapter aim to:

- **generate a description of the heat and power value chain; and**
- **identify critical GBEP indicators, based on the main characteristics of the value chain and likely impacts on sustainability.**

The critical GBEP indicators emerging from this chapter should be considered as additional to those identified under the previous step (Description of Institutional Context and Regulatory Framework) based on the sustainability requirements and drivers/objectives of the bioenergy policy. They should be included in the Summary Booklet in Chapter 6, along with comments on the relevant sustainability factors that led to their selection.

The questions in this chapter should be addressed to relevant sectoral experts and selected producer associations. Ideally, feedback should be sought as well from a sample of end-users, including both households and businesses, especially in relation to off-grid power applications. In order to answer the aforementioned questions, information and data available in national and international databases may be used, combined with expert judgement. In some cases, ballpark estimates based on experience will be necessary.

The questions are grouped into different sections, depending on:

- the type of feedstock used and its origin; and
- for off-grid power generation, the types of fuels and technologies that were displaced, if any.

Questions addressing the way the additional demand for each bioenergy feedstock was met are included in the feedstock questionnaire (Module 5.4).

Before addressing these issues, a few general, introductory questions are included below, with the aim to set the timeframe of the analysis and collect basic data on the role of bioenergy in the heat and power sectors.

Please provide the information below in relation to modern bioenergy for heat and power.

	Answers:
Year in which the bioenergy policy/programme and the related targets (if any) were adopted (to be referred to as baseline year[16]):	
Year of analysis (to be referred to as reference year):	
Bioenergy in the heat and power sectors ***Please provide the information below for the reference year.***	
HEAT:	
- Industry: MJ/year; share (%) of total primary energy supply.	
- Buildings: MJ/year; share (%) of total primary energy supply.	
- TOTAL: MJ/year; share (%) of total primary energy supply.	
POWER (ON-GRID):	
- MJ/year (or MWh/year);	
- share (%) of total primary energy supply.	
POWER (OFF-GRID):	
- Households: number; MJ/year (or MWh/year).	
- Businesses: number; MJ/year (or MWh/year).	
- TOTAL: number; MJ/year (or MWh/year).	

[16] If no policy/programme is in place to support the adoption of modern bioenergy technologies for heating and cooking, the year in which such technologies started being introduced in the country could be used as baseline.

5.2.1 Overview of bioenergy for heat and power pathway.

Please provide the information below in relation to modern bioenergy for heat and power.

	Answers
• **Bioenergy feedstocks:**	
○ **Crops/trees/grasses**: [repeat for each type of crop/tree/grass used as bioenergy feedstock]**.**	
○ **Crop/livestock/forest residues**: [repeat for each type of residue used as bioenergy feedstock].	
○ **Processing residues**: [repeat for each type of residue used as bioenergy feedstock].	
○ **Waste**: [repeat for each type of waste used as bioenergy feedstock].	
• **Main feedstock production/harvesting/collection areas** [repeat for each feedstock]:	
• **Main sites/plants for the preprocessing/pretreatment of biomass:**	
• **Main sites/installations for the production of heat and power (on-grid) from biomass:**	
• **Main technologies used for/in:**	
○ Biomass preprocessing/pretreatment:	
○ Heat Production:	
○ Power generation (on-grid):	
○ Power generation (off-grid):	

WHERE TO?

Finished this section?

Go to **Module 5.4** related to feedstock production/harvesting **before** proceeding to Section 5.2.2 in this Module.

5.2.2 Feedstock Transportation, Preprocessing/Pretreatment and Conversion.

Beside the indicators covering the feedstock stage, a number of additional GBEP indicators may be critical for the other stages of the bioenergy value chain, i.e., feedstock transportation, preprocessing/pretreatment and conversion. A few questions are included below, in order to support the identification of critical indicators associated with these stages, combined with the analysis of the requirements and drivers/objectives of the bioenergy policy.

	CRITICAL GBEP INDICATORS
• **On average, does the feedstock travel over long distances before reaching the plants for the preprocessing/pretreatment of biomass and/or for the production of heat and power?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 4 (Emissions of non-GHG air pollutants, including air-toxic);** **Indicator 18 (Net energy balance);** **Indicator 23 (Infrastructure and logistics for distribution of bioenergy).**
• **Are feedstock transportation and/or heat and power distribution concentrated along a few critical routes[17]?**	**Indicator 23 (Infrastructure and logistics for distribution of bioenergy).**
• **Is there significant room to increase the efficiency of biomass preprocessing/pretreatment and/or conversion using best available technologies?**	**Indicator 17 (Productivity[18]);** **Indicator 18 (Net energy balance).**
• **Are the main plants for the preprocessing/pretreatment of biomass and/or**	**Indicator 5 (Water use and efficiency).**

[17] As described under GBEP indicator 23 (Infrastructure and logistics for distribution of bioenergy), "critical routes are those which are subject to significant risk of disruption and which could not easily or quickly be replaced, such as pipelines, port facilities, etc., taking into account the relative volume capacity of each mode".

[18] Specifically, sub-indicator 17.2 (Processing efficiencies by technology and feedstock).

for the production of heat and power located in areas with medium, high or critical levels of water stress [as per SDG indicator 6.4.2]?	
• **Are the main plants for the preprocessing/pretreatment of biomass and/or for the production of heat and power located within major watersheds of the country, or within watersheds considered most vulnerable to pollution from effluents?**	**Indicator 6 (Water quality[19]).**
• **Is it likely that an improper management of by-products (e.g. biogas digestate, biochar, etc.) and/or effluents from plants for the preprocessing/pretreatment of biomass and/or for the production of heat and power led to negative impacts on soil quality?**	**Indicator 2 (Soil quality).**
• **Are the main plants for the preprocessing/pretreatment of biomass and/or for the production of heat and power located in conservation value areas?**	**Indicator 7 (Biological diversity)[20].**
• **Are the main plants for the preprocessing/pretreatment of biomass and/or for the production of heat and power located near inhabited areas?**	**Indicator 4 (Emissions of non-GHG pollutants, including air toxics).**
• **Is there significant co-firing of biomass in current fossil-fuel heat/power generation infrastructure?**	**Indicator 24 (Capacity and flexibility of use of bioenergy).**
• **Is there freedom of association and the effective recognition of the right to collective bargaining in the transportation and manufacturing sectors?**	**Indicator 11 (Change in income[21]); Indicator 12 (Jobs in the bioenergy sector[22]).**

[19] Specifically, sub-indicator 6.2 (Pollutant loadings to waterways and bodies of water attributable to bioenergy processing effluents, and expressed as a percentage of pollutant loadings from total agricultural processing effluents in the watershed).
[20] Specifically, sub-indicator 7.1 (Area and percentage of nationally recognized areas of high biodiversity value or critical ecosystems converted to bioenergy production).
[21] Specifically, sub-indicator 11.1 (Contribution of the following to change in income due to bioenergy production: wages paid for employment in the bioenergy sector in relation to comparable sectors).
[22] Specifically, sub-indicator 12.2 (Total number of jobs in the bioenergy sector and percentage adhering to nationally recognized labour standards consistent with the principles enumerated in the ILO Declaration on Fundamental Principles and Rights at Work, in relation to comparable sectors).

• **Are trainings and proper equipment provided to workers in plants for the preprocessing/pretreatment of biomass and for the production of heat and power, in order to minimize occupational health and safety risks?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities);** **Indicator 21 (Training and re-qualification of the workforce).**
• **Are adequate information/trainings and proper equipment provided to operators (including own-producing households and businesses) to safely run small-scale power generation units?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities).**

5.2.3 Domestic bioenergy consumption.

Please provide the information below for the reference year.

	Answers:
Share of bioenergy in final energy consumption:	
HEAT:	
- Industry: share (%) of final energy consumption.	
- Buildings: share (%) of final energy consumption.	
- TOTAL: share (%) of final energy consumption.	
POWER (ON-GRID): share (%) of final energy consumption.	
POWER (OFF-GRID):	
- Households: share (%) of households; share (%) of final energy consumption.	
- Businesses: share (%) of businesses; share (%) of final energy consumption.	
- TOTAL: share (%) of final energy consumption.	
Progress towards target/mandate:	
HEAT:	
- Industry: share (%) of target/mandate met.	
- Buildings: share (%) of target/mandate met.	
- TOTAL: share (%) of target/mandate met.	
POWER (ON-GRID): share (%) of target/mandate met.	
POWER (OFF-GRID):	
- Households: share (%) of target met.	
- Businesses: share (%) of target met.	
- TOTAL: share (%) of target met.	

5.2.4 Modern bioenergy use for heat and power.

A few questions related to the end-use side of the heat and power pathway are included below. Most of these questions focus on off-grid power generation, which is likely to trigger important effects on sustainability through direct substitution of fossil fuels and traditional use of biomass.

	CRITICAL GBEP INDICATORS
• **Is it likely that modern bioenergy consumption for heat and power led to a change in energy security and specifically in the diversity of the energy supply?**	**Indicator 22 (Energy diversity).**
• **Is modern bioenergy displacing traditional biomass use for heat production and/or the use of fossil fuels for heat and power generation?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 4 (Emissions of non-GHG air pollutants, including air toxics);** **Indicator 18 (Net energy balance);** **Indicator 20 (Change in the consumption of fossil fuels and traditional use of biomass).**
• **Is modern bioenergy displacing specifically the use of kerosene for lighting?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 4 (Emissions of non-GHG air pollutants, including air toxics);** **Indicator 14 (Bioenergy used to expand access to modern energy services);** **Indicator 15 (Change in mortality and burden of disease attributable to indoor smoke);** **Indicator 18 (Net energy balance);** **Indicator 20 (Change in the consumption of fossil fuels and traditional use of biomass).**
• **Is it likely that off-grid power generation (using modern bioenergy technologies) led to a change in access to modern energy services in rural areas?**	**Indicator 14 (Bioenergy used to expand access to modern energy services).**

• **Is it likely that off-grid power generation (using modern bioenergy technologies) led to a change in the income of households and businesses that gained access to electricity, e.g., through a change in the productivity of their income-generating activities?**	**Indicator 11 (Change in income).**

WHERE TO?

Finished this Module?

Add the identified critical indicators into the Summary Booklet in **Chapter 6**, adding a note as to the reason for criticality.

Then, go to **Chapter 7** "Rapid measurement of critical GBEP indicators through monitoring of relevant safeguards and good practices".

5.3 VALUE CHAIN DESCRIPTION AND IDENTIFICATION OF CRITICAL GBEP INDICATORS – HEATING AND COOKING (SMALL SCALE)

AIM

The questions in this chapter aim to:

- **generate a description of the heating and cooking (small scale) value chain; and**
- **identify critical GBEP indicators, based on the main characteristics of the value chain and likely impacts on sustainability.**

The critical GBEP indicators emerging from this chapter should be considered as additional to those identified under the previous step (Description of Institutional Context and Regulatory Framework) based on the sustainability requirements and drivers/objectives of the bioenergy policy. They should be included in the Summary Booklet in Chapter 6, along with comments on the relevant sustainability factors that led to their selection.

The questions in this chapter should be addressed to relevant sectoral experts and selected producer associations. Ideally, feedback should also be sought from a sample of end-users, including both households and businesses. In order to answer the questions, information and data available in national and international databases may be used, combined with expert judgement. In some cases, educated guesses will be necessary.

The questions are grouped into different sections, depending on:

- the type of feedstock used and its origin; and
- the types of fuels and technologies (for small-scale heating and cooking applications) that were displaced.

Questions addressing the way the additional demand for each heating and cooking fuel feedstock was met are included in the feedstock questionnaire (Module 5.4).

Before addressing these issues, a few general, introductory questions are included below, with the aim to set the timeframe of the analysis and collect basic data on modern bioenergy production and use in small-scale heating and cooking applications.

Please provide the information below in relation to modern bioenergy for heating and cooking (small scale).

	Answers:
Year in which the bioenergy policy/programme and the related targets (if any) were adopted (to be referred to as baseline year[23]):	
Year of analysis (to be referred to as reference year):	
Modern bioenergy for small-scale heating applications (for the reference year):	
- Households: number; MJ/year.	
- Businesses: number; MJ/year.	
- TOTAL: number; MJ/year.	
Modern bioenergy for small-scale cooking applications (for the reference year):	
- Households: number; MJ/year.	
- Businesses: number; MJ/year.	
- TOTAL: number; MJ/year.	

[23] If no policy/programme is in place to support the adoption of modern bioenergy technologies for heating and cooking, the year in which such technologies started being introduced in the country could be used as baseline.

5.3.1 Overview of modern bioenergy for heating and cooking (small scale) pathway.

Please provide the information below in relation to modern bioenergy for heating and cooking (small scale).

	Answers
• **Bioenergy feedstocks:**	
○ **Crops/trees/grasses**: [repeat for each type of crop/tree/grass used as bioenergy feedstock]**.**	
○ **Crop/livestock/forest residues**: [repeat for each type of residue used as bioenergy feedstock].	
○ **Processing residues**: [repeat for each type of residue used as bioenergy feedstock].	
○ **Waste**: [repeat for each type of waste used as bioenergy feedstock].	
• **Main feedstock production/harvesting/collection areas** [repeat for each feedstock]:	
• **Main sites/plants for the pretreatment of biomass:**	
• **Main technologies used for/in:**	
○ **Biomass pretreatment:**	
○ **Small-scale heating applications:**	
○ **Small-scale cooking applications:**	

WHERE TO?

Finished this section?

Go to **Module 5.4** related to feedstock production/harvesting **before** proceeding to Section 5.3.2 in this Module.

5.3.2 Feedstock Transportation, Preprocessing/Pretreatment and Conversion.

Beside the indicators covering the feedstock stage, a number of additional GBEP indicators may be critical for the other stages of the bioenergy value chain, i.e., feedstock transportation and conversion. A few questions are included below, in order to support the identification of critical indicators associated with these stages, combined with the analysis of the requirements and drivers/objectives of the bioenergy policy.

	CRITICAL GBEP INDICATORS
• **On average, does the feedstock travel over long distances before reaching the preprocessing/pretreatment plants and/or the end-users?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 4 (Emissions of non-GHG air pollutants, including air-toxic);** **Indicator 18 (Net energy balance);** **Indicator 23 (Infrastructure and logistics for distribution of bioenergy).**
• **Is it likely that the switch from traditional use of biomass to modern bioenergy technologies for cooking and heating led to a change in the time spent collecting biomass by the affected households?**	**Indicator 13 (Change in unpaid time spent by women and children collecting biomass).**
• **Is there significant room to increase biomass preprocessing/pretreatment and/or conversion efficiency using best available technologies?**	**Indicator 17 (Productivity);** **Indicator 18 (Net energy balance);** **Indicator 19 (Gross value added).**
• **Are the main plants for biomass preprocessing/pretreatment and/or conversion located in areas with medium, high or critical levels of water stress** [as per SDG indicator 6.4.2]**?**	**Indicator 5 (Water use and efficiency).**
• **Are the main plants for the preprocessing/pretreatment of biomass and/or for the production of heat and power located in conservation value areas?**	**Indicator 7 (Biological diversity)[24].**

[24] Specifically, sub-indicator 7.1 (Area and percentage of nationally recognized areas of high biodiversity value or critical ecosystems converted to bioenergy production).

• **Are the main plants for biomass preprocessing/pretreatment and/or conversion located near inhabited areas?**	**Indicator 4 (Emissions of non-GHG pollutants, including air toxics).**
• **Is there freedom of association and the effective recognition of the right to collective bargaining in the transportation and manufacturing sectors?**	**Indicator 11 (Change in income[25]);** **Indicator 12 (Jobs in the bioenergy sector[26]);** **Indicator 13 (Change in unpaid time spent by women and children collecting biomass).**
• **Are trainings and proper equipment provided to workers in plants for biomass preprocessing/pretreatment and/or conversion, in order to minimize occupational health and safety risks?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities);** **Indicator 21 (Training and re-qualification of the workforce).**
• **Are adequate information/trainings and proper equipment provided to households and businesses to safely operate small-scale plants and appliances for the production and use of biofuels for heating and cooking?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities).**

[25] Specifically, sub-indicator 11.1 (Contribution of the following to change in income due to bioenergy production: wages paid for employment in the bioenergy sector in relation to comparable sectors).

[26] Specifically, sub-indicator 12.2 (Total number of jobs in the bioenergy sector and percentage adhering to nationally recognized labour standards consistent with the principles enumerated in the ILO Declaration on Fundamental Principles and Rights at Work, in relation to comparable sectors).

5.3.3 Domestic bioenergy consumption.

Please provide the information below for the reference year.

	Answers
HEATING:	
• Households: share (%) of households; share (%) of final energy consumption.	
• Businesses: share (%) of businesses; share (%) of final energy consumption.	
• TOTAL: share (%) of final energy consumption.	
COOKING:	
• Households: share (%) of households; share (%) of final energy consumption.	
• Businesses: share (%) of businesses; share (%) of final energy consumption.	
• TOTAL: share (%) of final energy consumption.	
Progress towards target (if any): HEATING.	
• Households: share (%) of target met.	
• Businesses: share (%) of target met.	
• TOTAL: share (%) of target met.	
Progress towards target (if any): COOKING.	
• Households: share (%) of target met.	
• Businesses: share (%) of target met.	
• TOTAL: share (%) of target met.	

5.3.4 Modern bioenergy end-use for cooking and heating (small scale).

A few questions related to the end-use side of the cooking and heating (small scale) pathway are included below.

	CRITICAL GBEP INDICATORS
• **Are modern bioenergy applications displacing the use of fossil fuels for heating and cooking?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 4 (Emissions of non-GHG air pollutants, including air toxics);** **Indicator 18 (Net energy balance);** **Indicator 20 (Change in the consumption of fossil fuels and traditional use of biomass).**
• **Are modern bioenergy applications displacing inefficient woodfuel combustion for heating and cooking?**	**Indicator 1 (Lifecycle GHG emissions);** **Indicator 3 (Harvest level of wood resources);** **Indicator 4 (Emissions of non-GHG air pollutants, including air toxics);** **Indicator 18 (Net energy balance);** **Indicator 20 (Change in the consumption of fossil fuels and traditional use of biomass).**
• **Are modern bioenergy applications displacing traditional uses of biomass for heating and/or cooking purposes in indoor open stoves or fires with no chimney or hood?**	**Indicator 15 (Change in mortality and burden of disease attributable to indoor smoke).**
• **Is it likely that the introduction of modern bioenergy applications for heating and cooking led to a change in harvest levels of wood resources?**	**Indicator 3 (Harvest levels of wood resources);** **Indicator 7 (Biological diversity in the landscape)[27].**

[27] Specifically, sub-indicator 7.1 (Area and percentage of nationally recognized areas of high biodiversity value or critical ecosystems converted to bioenergy production)

• **Is it likely that the introduction of modern bioenergy applications for heating and cooking led to a change in the average time spent collecting biomass by the households and businesses that switched to such applications?**	**Indicator 13 (Change in unpaid time spent by women and children collecting biomass).**
• **Is it likely that the introduction of modern bioenergy applications for heating and cooking led to a change in the income of households and businesses that switched to such applications, e.g., through a change in energy costs and/or a change in the productivity of income-generating activities?**	**Indicator 11 (Change in income).**

WHERE TO?

Finished this Module?

Add the identified critical indicators into the Summary Booklet in **Chapter 6**, adding a note as to the reason for criticality.

Then, go to **Chapter 7** "Rapid measurement of critical GBEP indicators through monitoring of relevant safeguards and good practices".

5.4 VALUE CHAIN DESCRIPTION AND IDENTIFICATION OF CRITICAL GBEP INDICATORS – FEEDSTOCK

AIM **Understand the sustainability impacts and the critical GBEP indicators associated with the different types of biomass feedstocks used for modern bioenergy production in the country.**

Note: Issues associated with the other stages of bioenergy supply chains are addressed in the individual questionnaires, which should be filled in on the basis of the pathway(s) considered, i.e. transport (Module 5.1), heat and power (Module 5.2), and cooking and heating – small scale (Module 5.3).

It is important to note that the most significant sustainability impacts (both positive and negative) in bioenergy supply chains tend to arise upstream, especially when dedicated biomass production takes place.

Please answer the questions in this chapter separately for each biomass feedstock used for modern bioenergy production as part of the identified priority bioenergy pathways in the country.

5.4.1 Imported feedstock.

Please answer the following questions for each biomass feedstock used for modern bioenergy production:

	Answers
• **Is bioenergy feedstock imported?** *(Y/N)*	
• **Share of total bioenergy feedstock imported** *(%)*	

If feedstock is imported, there will be no sustainability impacts (at national level) associated with this upstream stage of the bioenergy supply chain. The net trade balance of the country, which is not measured by any specific GBEP indicator, will be affected though.

- **Are there a limited number of ports/international overland routes for the import of feedstock?**

CRITICAL GBEP INDICATOR: Indicator 23 (Infrastructure and logistics for distribution of bioenergy)

WHERE TO?

Imported feedstock?
Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

Return to the questionnaire in **Module 5.1/2/3** (depending on specific pathway) to identify critical GBEP indicators associated with the downstream stages of the value chain.

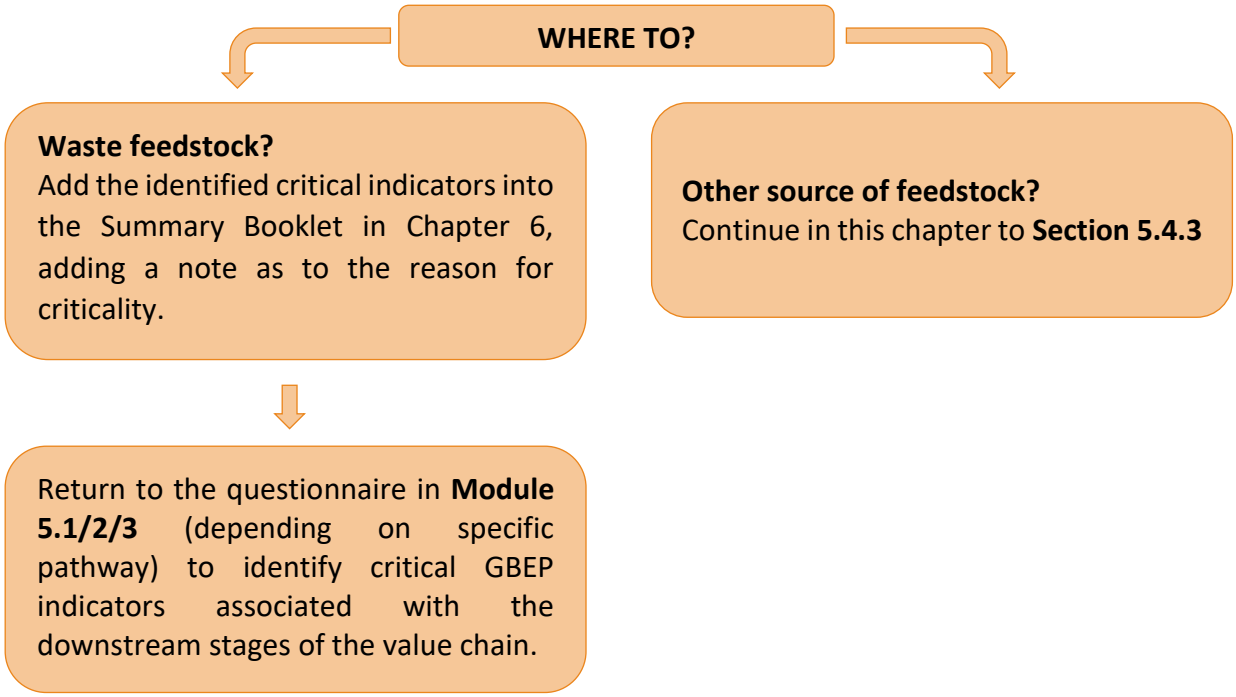
Other source of feedstock?
Continue in this Module to **Section 5.4.2**

5.4.2 Waste.

If waste (including unused residues and by-products[28]) is used as a feedstock, modern bioenergy production is unlikely to trigger significant negative impacts on sustainability at national level. As a matter of fact, if waste management/disposal improves as a result of its use as bioenergy feedstock, there may be a number of positive effects, e.g., in terms of GHG emissions, water quality, air quality and human health. However, depending on the requirements and drivers/objectives of the bioenergy

[28] Alternative uses of residues are addressed in section 5.4.3 below.

policy (see chapter 2), and on how the other stages of the value chain are managed, a few sustainability dimensions and related indicators could still be critical or at least relevant.



5.4.3 Crop/livestock/forest residues and processing residues.

In the context of this questionnaire:

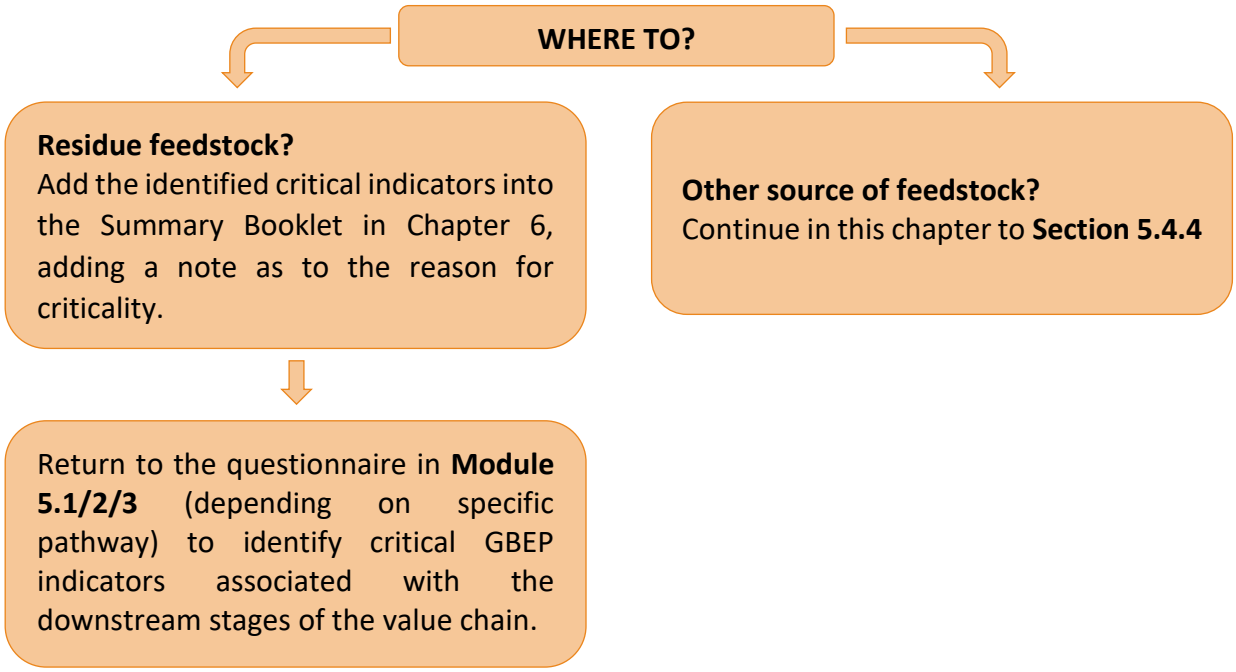
- *Crop residue* is plant material remaining after harvesting, including leaves, stalks, roots[29].
- *Livestock residues* predominantly include manures from cows, pigs, and chickens.
- *Forest residues* consist of small trees, branches, tops and un-merchantable wood left in the forest after the cleaning, thinning or final felling of forest stands[30].
- *Processing residues* encompass all materials and substances generated from biomass processing and which are not the end product(s) that a production process directly seeks to produce[31].

In order to identify the critical GBEP indicators associated with modern bioenergy production from residues, the competing uses of these residues shall be identified.

[29] https://stats.oecd.org/glossary/detail.asp?ID=480
[30] https://www.eubia.org/cms/wiki-biomass/biomass-resources/challenges-related-to-biomass/recovery-of-forest-residues/
[31] https://knowledge4policy.ec.europa.eu/node/9345_pt

- **What are the alternative uses of these residues that could be displaced?**

COMPETING USES OF RESIDUES	CRITICAL GBEP INDICATORS:
Feed	**Indicator 10 (Price and supply of a national food basket)**
Soil cover / amendment	**Indicator 2 (Soil quality)**
Traditional biomass use for cooking and heating	**Indicator 13 (Change in unpaid time spent by women and children collecting biomass)**
Other[32] (please specify)	



5.4.4 Crops, trees and grasses.

In case domestically produced agricultural crops, trees or grasses are used as bioenergy feedstock, in order to identify likely impacts on sustainability and critical GBEP indicators, it is important to estimate how the additional demand for each crop, tree and grass was met.

This should be done in consultation with relevant experts with an in-depth knowledge of the agricultural and forestry sectors (and related markets) in the country. Information and data available in national

[32] E.g., building material.

and international databases may be used, combined with expert judgement. In some cases, ballpark estimates based on experience will be necessary.

The additional demand for each crop/tree/grass may be met through any combination of the options described below. For each option deemed relevant/significant, the related questions and guidance will apply.

Furthermore, it should be checked whether the crop/tree/grass used as bioenergy feedstock is classified as an invasive species.

Estimating how the additional demand for the crop/tree/grass was met.

In order to obtain a preliminary but sound indication of likely impacts on sustainability, it is important to estimate how the additional demand for bioenergy feedstock was met, by answering the questions below. These questions should be addressed to a multidisciplinary team of experts with an in-depth knowledge of the domestic agricultural and forestry sectors and of related markets. Data from national and international databases (e.g. FAOSTAT) should be used, combined with expert judgement, as well as educated guesses in some cases.

To be able to answer the questions below, the following information (or an approximation of the same) for the baseline year (year in which the bioenergy policy and the related targets were adopted) and the current year or selected reference year, will be useful:

Information	**Baseline year**	**Reference year**
Harvested area (ha/y)		
Total feedstock harvested (tonnes/y)		
Yield (tonnes/ha/y)		
Total imports of feedstock (tonnes/y)		
Total exports of feedstock (tonnes/y)		
Final use(s) of feedstock at national level (tonnes/y)		

5.4.4.1 Reduced exports and/or increased imports.

If the additional demand for the crop/tree/grass was met through a reduction in exports and/or an increase in imports, significant impacts on sustainability are unlikely to arise at national level (as far as feedstock production is concerned) compared to a scenario without bioenergy demand.

NO CRITICAL GBEP INDICATOR

Note: The net trade balance of the country, which is not measured by any specific GBEP indicator, will be affected though.

5.4.4.2 Diversion from the food and feed markets.

If the additional demand for a crop or a residue (used as bioenergy feedstock) was met by diverting it from the food and feed markets, there might be a negative impact on food security.

CRITICAL GBEP INDICATOR: 10 (Price and supply of a national food basket)

Note: Possible impacts on food security should be carefully monitored especially in case of crops (used as bioenergy feedstock) that are part of the national food basket. However, if the domestic supply of these crops for food does not decrease after trade[33] and if their inflation-adjusted prices do not increase[34], it is unlikely that food security will be affected.

5.4.4.3 Increased domestic production.

If the additional demand for the crop/tree/grass was met through an increase in domestic production, it should be estimated whether this increase was due to an expansion in the harvested area or a yield increase, or both.

Expansion in harvested area.

In this case, it is important to determine: the changes in land use and land management that might have taken place; and the main characteristics of the areas where this expansion occurred. Furthermore, it is important to determine whether the crop/tree/grass used as bioenergy feedstock is classified as an invasive species.

Note: if the crop/tree/grass is cultivated in rotation or combination with other crops/trees/grasses, then the relative role of the feedstock considered (vs. those of these other crops/trees/grasses) should be considered when answering the questions below. Similarly, in case of multi-purpose crops/trees/grasses, of which only a fraction is used as bioenergy feedstock, the relative weight of this use (vs. all other uses) should be considered. Impact allocation can be done on the basis of either mass balance or economic value of the various crops/trees/grasses and of the related uses[35].

	CRITICAL GBEP INDICATORS
• **Is the crop/tree/grass used as a bioenergy feedstock a nationally recognized invasive species?**	**Indicator 7 (Biological diversity in the landscape), specifically 7.2 (invasive species)**
• **Is it likely that the expansion in the harvested area of the crop/tree/grass led to the conversion of natural forests and grasslands (including savannah), peatlands, and wetlands?**	**Indicator 1 (Lifecycle GHG emissions);**

[33] Data on the domestic supply of the main agricultural commodities for different uses are available in FAOSTAT for the vast majority of countries: http://www.fao.org/faostat/en/#data/FBS

[34] Agricultural producer prices should be considered. These are the prices received by farmers for their produce at the farm gate, i.e., at the point where the commodity leaves the farm. Data on these prices are available here: http://www.fao.org/prices/en/

[35] For guidance on impact allocation methods, please refer to the *Implementation Guide*.

	Indicator 7 (Biological diversity in the landscape)[36] **Indicator 8 (Land use and land-use change)[37]**
• **Is it likely that the expansion in the harvested area of the crop/tree/grass led to the conversion of nationally recognized areas of high biodiversity value or critical ecosystems?**	**Indicator 7 (Biological diversity in the landscape), specifically 7.1 (high biodiversity value)**
• **Is it likely that the expansion in the harvested area of the crop/tree/grass took place in areas:**	
○ Prone to soil degradation (e.g., erosion)	**Indicator 2 (Soil quality)**
○ With medium, high or critical levels of water stress [only in case of irrigation and for planted trees with high evapotranspiration rates]	**Indicator 5 (Water use and efficiency)**
○ Within watersheds considered most vulnerable to nutrient and/or pesticide pollution	**Indicator 6 (Water quality)**
○ With insecure land tenure rights	**Indicator 9 (Allocation and tenure of land)**
• **Are relevant conservation methods[38] used in the cultivation of the crop/tree/grass?**	**Indicator 2 (Soil quality)** **Indicator 6 (Water quality)** **Indicator 7 (Biological diversity in the landscape)[39]**

[36] Specifically sub-indicator 7.1 (Area and percentage of nationally recognized areas of high biodiversity value or critical ecosystems converted to bioenergy production).

[37] Specifically sub-indicator 8.4 (Net annual rates of conversion between land-use types caused directly by bioenergy feedstock production).

[38] As explained in the methodology sheet of GBEP indicator 7 (Biological diversity in the landscape) and specifically under sub-indicator 7.3 (Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used), these methods include: no-till or low-till agriculture; integrated pest management; integrated nutrient management; maintenance or enhancement of agrobiodiversity; agroforestry/intercropping, and low impact harvesting; low impact forest management and wood harvest; maintenance and/or enhancement of ecological corridors and/or buffer zones; restoration or conservation of areas within and around production areas for biodiversity and ecosystems; monitoring populations of flagship and/or indicator species.

[39] Specifically, sub-indicator 7.3 (Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used).

• **Is it likely that the expansion in the harvested area of the crop/tree/grass led to the displacement of crops that are part of the national food basket?**	**Indicator 10 (Price and supply of national food basket)**

Note: If trade compensates for the above and the domestic supply of the crop for food and feed does not decrease[40] (after trade) and if their inflation-adjusted producer price does not increase[41], food security might not be affected and Indicator 10 might not be critical. The displacement of crops could lead to indirect land use change, which is not explicitly addressed by the GBEP indicators.

• **Is there a high prevalence of informal jobs in the agricultural sector?**	**Indicator 12 (Jobs in the bioenergy sector)[42]**
• **Is the crop/tree/grass harvested manually, with high risk of occupational injury, illness and fatalities?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities)**

Yield increase.

In this case, it is important to determine how this yield increase was achieved, i.e., through the introduction of higher-yielding species or improved varieties; increased use of fertilizers and/or pesticides; increased irrigation; increased mechanization; and/or improved management practices.

Introduction of higher-yielding species.

• **Were alien species introduced, potentially leading to the displacement of indigenous species?**	**Indicator 7 (Biological diversity in the landscape)**

Introduction of improved varieties.

The introduction of improved varieties is unlikely to trigger significant impacts on sustainability. As a matter of fact, the resulting increase in productivity could reduce pressure on natural resources. However, the potential of loss of genetic diversity could exist.

• **Were varieties introduced in a way that could potentially lead to the loss of indigenous species and crop genetic diversity?**	**Indicator 7 (Biological diversity in the landscape)**

Increased use of fertilizers and/or pesticides.

• **An increase in the use of fossil fuel-based fertilizers and pesticides results in increased GHG emissions.**	**Indicator 1 (Lifecycle GHG emissions)**

[40] Data on the domestic supply of the main agricultural commodities for different uses are available in FAOSTAT for the vast majority of countries: http://www.fao.org/faostat/en/#data/FBS

[41] As explained above, these are the prices received by farmers for their produce at the farm gate, i.e., at the point where the commodity leaves the farm. Data on these prices are available here: http://www.fao.org/prices/en/

[42] Specifically sub-indicator 12.2 (Total number of jobs in the bioenergy sector and percentage adhering to nationally recognized labour standards consistent with the principles enumerated in the ILO Declaration on Fundamental Principles and Rights at Work, in relation to comparable sectors).

• **Is there significant production of the crop/tree/grass within conservation value areas?**	**Indicator 7 (Biological diversity in the landscape)**
• **Is there significant production of the crop/tree/grass within watersheds considered vulnerable to nutrient and/or pesticide pollution?**	**Indicator 6 (Water quality)**
• **Is it likely that the increased application of fertilizers and pesticides led to negative impacts on soil quality, e.g., through increased tillage, soil compaction (due to the increased use of heavy machinery), and/or soil pollution/contamination?**	**Indicator 2 (Soil quality)**
• **Is it likely that the increased application of fertilizers and/or pesticides resulted in increased occupational health and safety risks for agricultural workers? Were these workers provided with adequate training and equipment?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities)** **Indicator 21 (Training and requalification)**
Increased irrigation.	
• **Is it likely that the increase in irrigation of the crop/tree/grass took place in areas with medium, high or critical levels of water stress [as per SDG indicator 6.4.2]?**	**Indicator 2 (Soil quality)** **Indicator 5 (Water use and efficiency)**
Increased mechanization.	
• **(Increased) mechanization will result in higher GHG emissions and emissions of non-GHG air pollutants, including air toxics.**	**Indicator 1 (Lifecycle GHG emissions)** **Indicator 4 (Emissions of non-GHG air pollutants, including air toxics)**
• **Is it likely that the (increased) mechanization resulted in increased tillage and/or soil compaction?**	**Indicator 2 (Soil quality)**
• **Is it likely that the (increased) mechanization, especially of the harvesting process, led to the displacement of jobs in the agricultural sector?**	**Indicator 12 (Jobs in the bioenergy sector)** **Indicator 21 (Training and re-qualification of the workforce)**
• **Is it likely that the (increased) mechanization had an impact on the incidence of occupational injury, illness and fatalities among agricultural workers?**	**Indicator 16 (Incidence of occupational injury, illness and fatalities)**

Improved management practices.

If the increase in efficiency was achieved through improvements in management practices, no negative impacts are likely to be associated with the yield increase. On the contrary, there might be positive effects on a few sustainability dimensions.

For instance, the following Climate-Smart Agriculture (CSA) practices may lead to an increase in productivity and to an improvement in the overall sustainability of agricultural systems, e.g. in terms of GHG emissions, soil quality, water use efficiency, water quality and biodiversity. These practices are covered in Chapter 7.

WHERE TO?

Finished this Module?

Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

Return to the questionnaire in **Module 5.1/2/3** (depending on specific pathway) to identify critical GBEP indicators associated with the downstream stages of the value chain.

6 VISUALIZATION OF RESULTS OF PRIORITIZATION OF GBEP INDICATORS - SUMMARY BOOKLET

AIM

This booklet can be used to summarize the Rapid Implementation of the GBEP Sustainability Indicators. It should be used in conjunction with other chapters of the handbook to create an overview of the institutional framework (Chapter 2), the value chain description and the critical GBEP indicators (Chapter 5), and overview of relevant safeguards and good practices (Chapter 7).

Rapid Implementation of the GBEP Sustainability Indicators for Bioenergy in _____ *(country)*

6.1 Bioenergy Pathway(s) analyzed

Use Chapter 3 to fill in this table. Using the criteria for pathway choice provided in Chapter 3, users should comment on which of these criteria influenced the decision of pathway.

Bioenergy Pathway	**Comments on choice of pathway**

6.2 Critical GBEP Indicators (for each bioenergy pathway)

Critical indicators are based on two criteria: the sustainability requirement and/or objective of bioenergy policy (Chapter 3); and the sustainability risks identified along the bioenergy pathway (Chapter 5).

***How to use this table**: When answering questions in Chapter 3 and Chapter 5, if a risk and/or benefit/target is identified that leads to a critical GBEP indicator, that indicator should be noted in this table as critical. A comment should be provided to explain why the indicator was identified as critical. If an indicator is shown to be critical due to multiple factors, multiple comments should be provided to explain each factor. For example, Indicator 1 (Lifecycle GHG emissions) may be critical due to the national target to reduce GHG emissions from energy, due to LUC caused by agricultural expansion and due to long transport distances between feedstock production zones and bioenergy plants. It would be inserted in the table as seen below.*

PATHWAY: _____		
Indicator	**Is it critical? Y/N**	**Comments on criticality of indicator**
1. Lifecycle GHG emissions	*Y*	*National target to reduce GHG emissions from transport sector* *LUC of natural areas caused by agricultural expansion* *Long distances between feedstock production zones and bioenergy plants*
2. Soil quality		
3. Harvest levels of wood resources		
4. Emissions of non-GHG air pollutants, including air toxics		
5. Water use and efficiency		
6. Water quality		
7. Biological diversity in the landscape		
8. Land use and land-use change related to bioenergy feedstock production		

9. Allocation and tenure of land for new bioenergy production		
10. Price and supply of a national food basket		
11. Change in income		
12. Jobs in the bioenergy sector		
13. Change in unpaid time spent by women and children collecting biomass		
14. Bioenergy used to expand access to modern energy services		
15. Change in mortality and burden of disease attributable to indoor smoke		
16. Incidence of occupational injury, illness and fatalities		
17. Productivity		
18. Net energy balance		
19. Gross value added		
20. Change in consumption of fossil fuels and traditional use of biomass		
21. Training and re-qualification of the workforce		
22. Energy diversity		
23. Infrastructure and logistics for distribution of bioenergy		
24. Capacity and flexibility of bioenergy use		

7 MONITORING OF SAFEGUARDS AND GOOD PRACTICES RELEVANT FOR CRITICAL GBEP INDICATORS

AIM

Provide a monitoring framework for good practices and safeguards that may minimize risks and increase benefits in relation to the sustainability dimensions addressed by the GBEP indicators.

Once the critical GBEP indicators have been identified, they should be measured in order to assess the sustainability impacts of the selected bioenergy pathway(s). Detailed methodologies are described in the indicator report (GBEP, 2011), which also includes several proxies for selected indicators. Further guidance on the measurement of the GBEP indicators may be found in the Implementation Guide (GBEP, 2020), along with additional proxies.

In case there are not sufficient resources (e.g. data, capacity) available for implementing the aforementioned methodologies or for applying the related proxies, relevant safeguards and good practices that may minimize risks and increase benefits in relation to the sustainability dimensions addressed by the GBEP indicators could be monitored. More precisely, the level of uptake of such safeguards and good practices by economic operators along the bioenergy supply chain(s) should be assessed over time. This approach may provide a useful preliminary indication of likely impacts on sustainability of the selected bioenergy pathway(s). However, it should be considered as a starting point for and/or a complement to the standard measurement of the GBEP indicators, as opposed to an alternative to it.

7.1 Relevant safeguards and good practices

A list of relevant safeguards and good practices is provided below, grouped into two tables.

The first one (Table 1) includes selected **Climate-Smart Agriculture (CSA) practices**. These CSA practices may lead to an increase in productivity and to an improvement in the overall sustainability of agricultural systems, e.g. in terms of GHG emissions, soil quality, water use efficiency, water quality and biodiversity, etc. For each of them, a description of the main benefits is provided, along with the list of GBEP indicators positively affected.

The second table (Table 2) comprises key **safeguards and good practices that can implemented by operators** along the supply chain to minimize risks and increase benefits in relation specifically to social and economic sustainability. Specific safeguards and good practices are listed and their relevant benefits/objectives are included, along with the list of GBEP indicators positively affected.

Table 1. CSA practices, related benefits and GBEP indicators positively affected.

CSA Practice	Benefits of the CSA practice that are common to most crop production systems	GBEP indicators positively affected
Agroforestry	• Diversification of income • Additional source of biomass and C sink • Crop shading • Provision of shelters and ecological corridors for wild species • Resource for pollinators • Wind breaking barriers • Prevention of soil erosion • Efficiency improvements in the use of nutrients and fertilizers, minimize nutrient losses → reduction in soil and groundwater pollution	Indicator 1 (Lifecycle GHG emissions) Indicator 2 (Soil quality) Indicator 3 (Harvest levels of wood resources) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape) Indicator 10 (Price and supply of a national food basket) Indicator 11 (Change in income) Indicator 12 (Jobs in the bioenergy sector) Indicator 17 (Productivity)
Green hedges/borders	• Reduction in soil erosion, water and nutrients runoff • Diversification of income • Additional source of biomass and C sink • Provision of shelters and ecological corridors for wild species • Resource for pollinators • Wind breaking barriers • Efficiency improvements in the use of nutrients and fertilizers, minimize nutrient losses → reduction in soil and groundwater pollution.	Indicator 1 (Lifecycle GHG emissions) Indicator 2 (Soil quality) Indicator 3 (Harvest levels of wood resources) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape) Indicator 11 (Change in income) Indicator 12 (Jobs in the bioenergy sector) Indicator 17 (Productivity)

Crop rotation	• Enhancement of nutrient and pest management • Increase in productivity • Enhancement of biodiversity • Reduction in soil erosion • Diversification of income opportunities	Indicator 2 (Soil quality) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape) Indicator 11 (Change in income)
Intercropping	• Enhancement of nutrient and pest management • Reduction in nutrients leaching and runoff • Increase in productivity • Enhancement of biodiversity • Reduction in soil erosion • Resource for pollinators • Diversification of income opportunities • Control of weeds → reduction in herbicide requirements → reduction in soil and groundwater pollution	Indicator 2 (Soil quality) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape) Indicator 11 (Change in income)
Almost constant soil cover, both dead (crop residues) or alive (cover or catch crops), in terms of space (at least 30% of soil surface) and time.	• Reduction in soil erosion and soil compaction • Reduction in water evaporation and runoff • Minimization of nutrient losses • Replenishment of soil nutrients • Control of weeds → reduction in herbicides requirements → reduction in soil and groundwater pollution	Indicator 2 (Soil quality) Indicator 5 (Water use and efficiency) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape)
Cultivation of non-income crops: e.g. cover crops, catch crops, green cover between rows	• Bio-drilling → reduction in soil compaction • Increase in soil organic matter • Shelter for wild species • Control of weeds • Reduction in nutrients leaching and runoff • Reduction in soil erosion	Indicator 2 (Soil quality) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape)

Integrated Pest Management (IPM)	• Reduction in amount of pesticides application → reduction in air, water and soil pollution and contamination • Reduction in impacts of herbicides and pesticides on micro- and meso-fauna, such as pollinators • Enhancement of energy efficiency due to lower number of interventions for input distribution	Indicator 2 (Soil quality) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape)
Alternative use of crop residues to avoid burning	• Reduction in GHG and non-GHG emissions • Provision of additional income for farmers	Indicator 1 (Lifecycle GHG emissions) Indicator 4 (Emissions of non-GHG air pollutants, including air toxics) Indicator 11 (Change in income) Indicator 12 (Jobs in the bioenergy sector)
Reduced tillage	• Reduction in fuel consumption → enhancement in energy efficiency → reduction in GHG and non-GHG emissions • Preservation and restoration of soil quality in terms of soil organic matter, soil biodiversity and water holding capacity • Spatial redistribution of soil organic carbon, with higher concentration in the soil layers • Reduction in soil erosion and water evaporation	Indicator 1 (Lifecycle GHG emissions) Indicator 2 (Soil quality) Indicator 4 (Emissions of non-GHG air pollutants, including air toxics) Indicator 5 (Water use and efficiency) Indicator 18 (Net energy balance)
Efficient irrigation technologies and management	• Efficient and sustainable management of water resources	Indicator 5 (Water use and efficiency)
Circular use of water: use of wastewater for irrigation purposes	• Efficient and sustainable management of water resources	Indicator 5 (Water use and efficiency)

Utilizing GPS-enabled precision farming	• Improvements in efficiency of fertilizers and pesticides • Improvements in energy efficiency • Reduction in soil, water and air pollution • Creation of new job opportunities	Indicator 1 (Lifecycle GHG emissions) Indicator 2 (Soil quality) Indicator 4 (Emissions of non-GHG air pollutants, including air toxics) Indicator 6 (Water quality) Indicator 7 (Biological diversity in the landscape) Indicator 12 (Jobs in the bioenergy sector) Indicator 18 (Net energy balance)

Table 2. Socio-economic safeguards and good practices, and GBEP indicators positively affected.

Specific approaches to operationalize good socio-economic practices in bioenergy operations	Benefits/objectives of socio-economic safeguards and good practices	GBEP indicators positively affected
• Consultation • Mapping of customary land rights • Fair compensation to landowners/users • Conflict resolution mechanisms	Safeguarding access to land for local communities	Indicator 9 (Allocation and tenure of land for new bioenergy production)
• Adherence to: ▪ ILO Declaration on Fundamental Principles and Rights at Work and related Conventions[43] ▪ ISO 26000 - Social Responsibility ▪ Social Accountability (SA) 8000 • Living wage	Ensuring decent work	Indicator 11 (Change in income) Indicator 12 (Jobs in the bioenergy sector)
• Contracts with local goods and service providers, including smallholders • Fair and transparent pricing • Profit sharing	Promoting income generation and facilitating the inclusion of smallholders	Indicator 11 (Change in income) Indicator 12 (Jobs in the bioenergy sector)

[43] (e.g. Occupational Safety and Health; Minimum Age; Collective bargaining, etc.). More information available on the ILO website: https://www.ilo.org/global/standards/introduction-to-international-labour-standards/conventions-and-recommendations/lang--en/index.htm

• Integrated Food and Energy Systems • Introduction of improved varieties, agricultural inputs and/or equipment • Trainings on good agricultural practices for local producers	Safeguarding or enhancing local food security	Indicator 10 (Price and supply of a national food basket) Indicator 13 (Change in unpaid time spent by women and children collecting biomass) Indicator 14 (Bioenergy used to expand access to modern energy services) Indicator 15 (Change in mortality and burden of disease attributable to indoor smoke) Indicator 17 (Productivity) Indicator 20 (Change in consumption of fossil fuels and traditional use of biomass) Indicator 21 (Training and re-qualification of the workforce)
• Development or improvement of local energy infrastructure • Provision of energy for local and/or domestic use • Introduction of improved cookstoves	Improving local access to modern energy services	Indicator 13 (Change in unpaid time spent by women and children collecting biomass) Indicator 14 (Bioenergy used to expand access to modern energy services) Indicator 15 (Change in mortality and burden of disease attributable to indoor smoke) Indicator 22 (Energy diversity)
• Gender-sensitive corporate conduct • Gender-related corporate policies and programmes • Women in leadership positions	Ensuring gender equity	Crosscutting
• Development or improvement of local infrastructure		Crosscutting

• Training and education programmes	Enhancing community development	
• Microlending and financial support mechanisms		

7.2 Monitoring safeguards and good practices

In order to support the monitoring over time of the level of uptake of the aforementioned safeguards and good practices by economic operators along the bioenergy supply chain(s), a table is provided below (Table 3). Any other relevant safeguards and good practices being implemented by domestic operators (beside those included in the above tables) should be considered as well at the end of the table.

Please complete the table below, providing the following information for each practice:

- ***whether the practice is recognized and/or promoted at national level (i.e. recognized/required by law and/or incentivized by national policies);***
- ***an estimation of the current level of uptake;***
- ***the change in level of uptake over time, compared with the baseline year; and***
- ***comments concerning the specific practices/approaches and relevant national mechanisms, if applicable.***

Relevant experts with an in-depth knowledge of the domestic agricultural, forestry and bioenergy sectors and related markets should be in a position to provide a ballpark estimate of the level of implementation of the safeguards and practices described above and of related changes over time.

A few standards for the certification of bioenergy feedstocks and fuels include provisions related to the implementation of selected safeguards and practices. Data on the number of certified producers and/or on the share of certified output could thus represent a valuable source of information in some instances.

Table 3. Monitoring framework for good practices.

PRACTICE	**RECOGNIZED AND/OR PROMOTED** *(Yes/ No)*	**CURRENT LEVEL OF UPTAKE** *(None/ Low/ Medium/ High)*	**CHANGE IN LEVEL OF UPTAKE COMPARED TO BASELINE** *(Decrease/ Stable/ Increase)*	**COMMENTS** *(Specific practices adopted and relevant national mechanisms for recognition/promotion of said practices)*
CSA PRACTICES				
Agroforestry				
Green hedges/borders				
Crop rotation				
Intercropping				
Almost constant soil cover				
Cultivation of non-income crops				
Integrated Pest Management (IPM)				
Alternative use of crop residues to avoid burning				
Reduced tillage				

Efficient irrigation technologies and management				
Circular use of water: use of wastewater for irrigation purposes				
Utilizing GPS-enabled precision farming				
SOCIO-ECONOMIC SAFEGUARDS AND GOOD PRACTICES				
Consultation				
Mapping of customary land rights				
Fair compensation to landowners/users				
Conflict resolution mechanisms				
• Adherence to: ▪ ILO Declaration on Fundamental Principles and Rights at Work and related Conventions[44]				

[44] (e.g. Occupational Safety and Health; Minimum Age; Collective bargaining, etc.)

▪ ISO 26000 - Social Responsibility ▪ Social Accountability (SA) 8000				
Living wage				
Contracts with local goods and service providers, including smallholders				
Fair and transparent pricing				
Profit sharing				
Integrated Food and Energy Systems				
Introduction of improved varieties, agricultural inputs and/or equipment				
Trainings on good agricultural practices for local producers				
Development or improvement of local energy infrastructure				

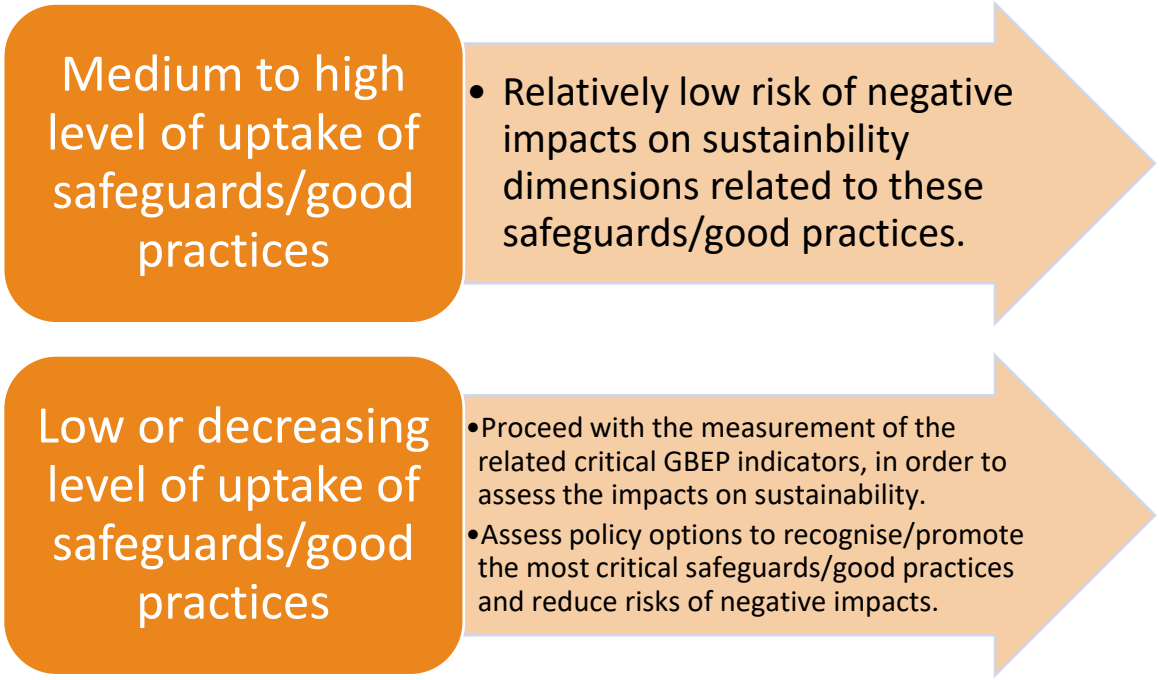
Provision of energy for local and/or domestic use				
Introduction of improved cookstoves				
Gender-sensitive corporate conduct				
Gender-related corporate policies and programmes				
Women in leadership positions				
Development or improvement of local infrastructure				
Training and education programmes				
Microlending and financial support mechanisms				

7.3 Results of the monitoring framework

Once the table has been filled out, attention should be paid to the level of uptake of safeguards and good practices relevant for the GBEP indicators that are deemed most critical. All else equal, a **medium to high level of uptake** of such practices by operators along the bioenergy supply chain(s) should result in a lower risk of negative impacts (or even a higher chance of positive impacts, in some cases) on the sustainability dimensions addressed by these critical indicators. Conversely, if the **level of uptake is low or if it has been decreasing**, it would be important to proceed with the measurement of the related critical GBEP indicators, in order to assess the impacts on sustainability from the selected bioenergy pathway(s).

Ideally, these **critical indicators should be measured** by applying the detailed methodologies discussed in the indicator report (GBEP, 2011). Alternatively, the indicator proxies described in the report and in the Implementation Guide (GBEP, 2020) could be used.

In parallel, as part of the recommendations emerging from the application of the RIF, **policy-makers should be encouraged** to explore the policy options for the promotion of the uptake of the aforementioned safeguards and good practices.



WHERE TO?

Finished this Chapter?

You have completed the Rapid Implementation of the GBEP Sustainability Indicators.

After completing all steps in the RIF, the final results are visualized in Chapter 2, Chapter 5, Chapter 6 and Chapter 7. You should save these files for your records.

Share results with Multi-stakeholder working group and policy makers

The results of the Implementation should be shared first with all members of the multi-stakeholder working group for validation of results. They should then be shared with relevant policy makers, underlining the following main points:

- Current bioenergy policy framework (Chapter 2).
- Description of value chain of selected bioenergy pathways (Chapter 5).
- The most critical sustainability issues of the selected bioenergy pathways, based on the description of the value chain (Chapter 6).
- The critical GBEP Sustainability Indicators for assessing the sustainability of the selected bioenergy pathways (Chapter 6).
- Comments on the uptake of safeguards and best practices, and recommendations for future priorities (Chapter 7).

Share results with GBEP

The results of the Rapid Implementation can be shared with the GBEP community in order to:

- Organize events to share the results and lessons learned from the rapid implementation within the international community and provide feedback on improvements to the Framework for future users; and
- Receive technical assistance in formulating a project for full implementation of the GBEP indicators.

The results of the Implementation should be sent to GBEP-secretariat@fao.org.