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Linkages between the Sustainable Development Goals (SDGs) and the GBEP Sustainability Indicators for Bioenergy (GSI)

Technical Paper for the GBEP Task Force on Sustainability

prepared for

GBEP
Global Bioenergy Partnership

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sponsored by

Federal Ministry for Economic Affairs and Energy

Umwelt Bundesamt

Darmstadt, Berlin, Heidelberg, February 2018

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Background

The Global Bioenergy Partnership's (GBEP) Task Force on Sustainability (TFS) developed the GBEP Sustainability Indicators for Bioenergy (GSI) from 2009 to 2011. After the GSIs had been tested in a number of countries, the TFS was reopened in May 2015 with the new focus of enhancing the practicality of the GSIs by producing an Implementation Guide to complement the earlier GSI report (GBEP 2011).

Part of this is to reflect on the GSIs in the context of the **Sustainable Development Goals** (SDGs)[1], which were endorsed by the United Nations in September 2015.

As a contribution to this reflection, this Technical Paper was prepared to highlight the linkages between the SDGs and the GSIs and to determine how they may be mutually reinforcing.

Acknowledgements

The paper was prepared with funding from the German Ministry for Economy and Energy (BMWi) through a contract with the German Federal Environment Agency (UBA).

Input was also given by colleagues from IFEU and IINAS.

The extensive and excellent comments and feedback received from GBEP partners and observers during the International GBEP Workshop "Linkages between Sustainable Development Goals and GBEP Sustainability Indicators"[2] held July 3-4, 2017 in Bonn, Germany, are **very much appreciated,** as well as the editing support from the GBEP Secretariat.

Any error, misconception or omission remain in the responsibility of the authors.

[1] The SDGs are part of the Resolution adopted by the UN General Assembly on 25 September 2015 "Transforming our world: the 2030 Agenda for Sustainable Development" (UN 2015b).

[2] For agenda, presentations, conclusions and List of Participants see http://www.globalbioenergy.org/events1/events-20163/events-201610/en/

1 Biomass and Sustainable Development

After the release of the GSIs at the end of 2011, two key events have occurred that need consideration for future biomass developments:

- Adoption of the SDGs in September 2015 by the UN General Assembly, and
- The Paris Agreement on climate change in December 2015.

The role of bioenergy with regard to the SDGs is discussed in more detail in the following sections.

The **climate change** issue also has a strong relation to bioenergy – it can be a positive or a negative relation, depending on which biomass is used, from where, how and for what purpose[3].

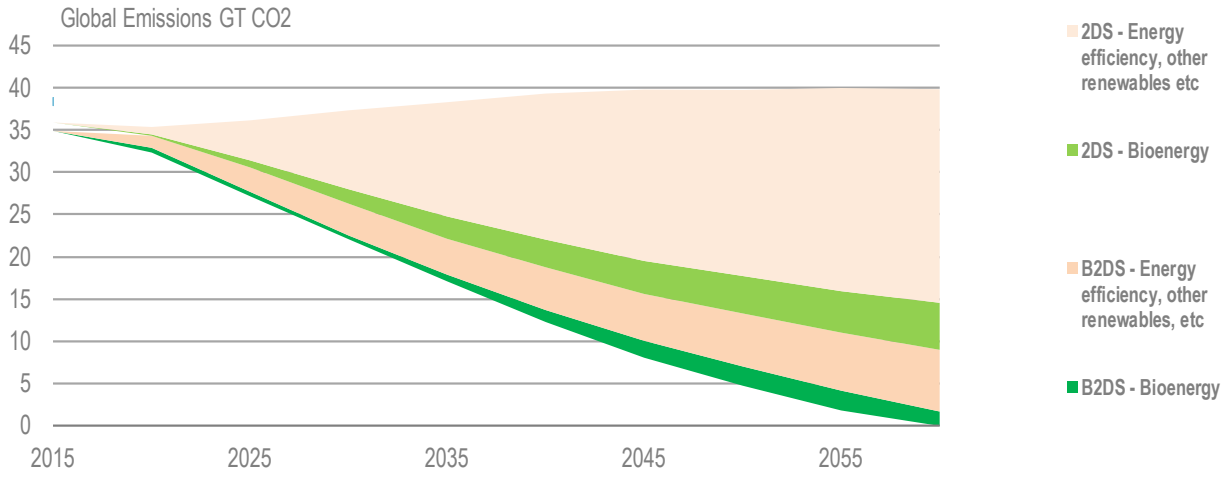
The recent IEA Bioenergy Roadmap (IEA 2017a) identified technology milestones and policy actions needed to unlock the bioenergy potential in a sustainable global energy system that stays within the 2 °C limit of the Paris Agreement. For this, the IEA developed two scenarios with different levels of "climate ambition" (IEA 2017b):

- **2DS** (two degree scenario) aims at limiting global average temperatures from rising more than 2°C by 2100, while
- **B2DS** (below two degree scenario) aims at a "below 2 °C" world.

A very relevant finding from a comparison these scenarios is that the higher the climate ambition, the more bioenergy is needed to decarbonize the global economy (see Figure 1).

[3] For a discussion of the climate impacts of bioenergy see e.g. Cowie (2017), IEA Bio (2018) and Strapasson et al. (2017), and for the role of bioenergy with regard to "negative emissions" requirements see e.g. EASAC (2018), Fajardy & Mac Dowell (2017), Heck et al. (2018), and van Vuuren et al. (2017).

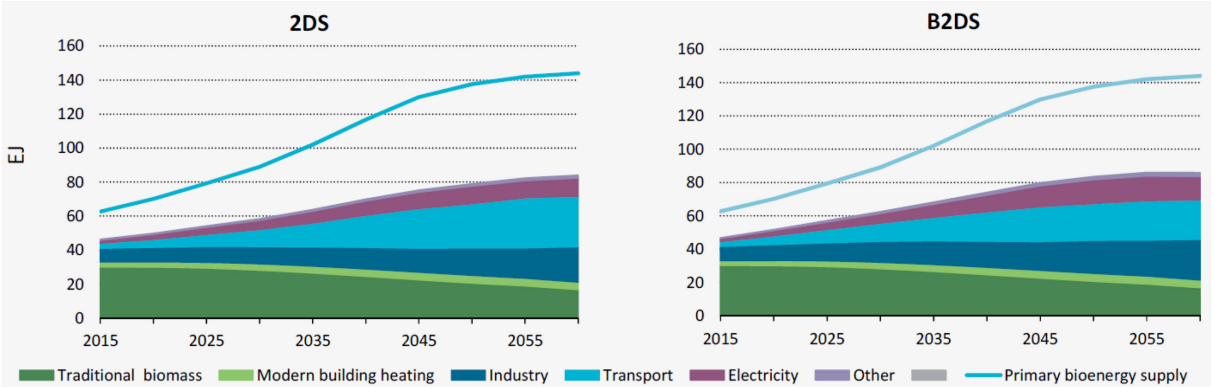
Figure 1 Bioenergy Contribution to CO_2 Reductions in the IEA Bioenergy Roadmap



Source: IEA (2017a)

To achieve the CO_2 reductions in the IEA roadmap, the bioenergy share in the global energy system **will have to increase in both scenarios** (see Figure 2).

Figure 2 Bioenergy Contribution to Final and Primary Energy Demand in the IEA Bioenergy Roadmap



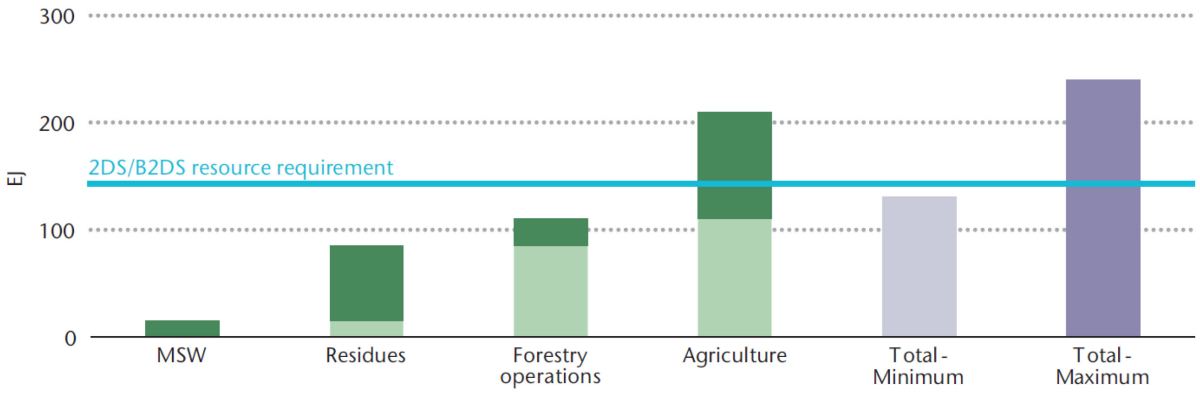
Source: IEA (2017a)

Both scenarios require about 140 EJ of **primary** energy from biomass, i.e. 2.5 times the value for 2015. Yet, the **final** energy from biomass will increase "only"

1.5 times compared to 2015, as the IEA assumes a significant improvement in the efficiency of using biomass for energy[4].

All in all, the IEA roadmap implies a massive increase in sustainable bioenergy supply (Figure 2), of which most could be obtained by mobilizing **biogenic residues and wastes** (Figure 3), and from rehabilitating marginal and degraded lands, which are substantial in many countries (Fritsche et al. 2017; IRENA 2017).

Figure 3 Global Bioenergy Potentials in the IEA Bioenergy Roadmap



Source: IEA (2017a)

The IEA roadmap strongly argues that to achieve the required increase in bioenergy supply and use, an appropriate approach to **sustainability governance** for bioenergy is needed. For this, the SDGs could be used as a normative framework, as they are quite strongly related to bioenergy, as described in the next section.

[4] For this, the IEA assumes that "traditional" biomass use for cooking (mostly in developing countries) can be reduced and replaced by modern bioenergy systems (e.g. improved cookstoves, biogas, renewable electricity).

2 Biomass and the SDGs

The 17 SDGs represent a **normative framework** which could be used to "define" sustainable development in general and their 169 targets give quantitative steps towards achieving the goals (UN 2015b; UN-ESC 2017a).

Each country will have to translate the SDGs into its own development agenda and to report to the UN on respective achievements[5].

There is a multitude of **indicators** for the SDGs, i.e. quantitative or qualitative expressions to "measure" achieving the goals and targets which are to be implemented and used on the national level[6].

The SDGs are meant to give orientiation for the future global development – but disregarding the relevance of biomass for the global food, feed, fibre and energy systems, the SDGs do **not make any reference** to biomass, or bioenergy, or biofuels – and neither to more "modern" concepts such as biorefineries.

Yet bioenergy, as part of the overall use of biomass (i.e. the "bioeconomy"), is expected to **increase globally** driven by several SDGs, but could also be subject to sustainability safeguards from other SDGs, as indicated in Table 1.

[5] The UN High-Level Political Forum on Sustainable Development is responsible for reviewing country progress towards the SDGs – for first results see HLPF (2017), and for details on the review process see UN-DESA (2018). In 2018, the HLPF will review progress on SDGs 7 (energy) and 15 (land), among others – see https://sustainabledevelopment.un.org/hlpf/2018

[6] See for details on the SDG indicators UN-ESC (2017b) and https://unstats.un.org/sdgs/iaeg-sdgs/

Table 1 Role of the SDGs for biomass supply and use

SDG	Key wording	Driver	Safe-guard
	End poverty in all its forms everywhere	(✓)	(✓)
	**End hunger, achieve food security and improved nutrition and promote sustainable agriculture**	✓	✓
	Ensure healthy lives and promote well-being for all at all ages	(✓)	(✓)
	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all		
	Achieve gender equality and empower all women and girls	(✓)	(✓)
	Ensure availability and sustainable management of water and sanitation for all	(✓)	(✓)
	**Ensure access to affordable, reliable, sustainable and modern energy for all**	✓	(✓)
	**Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**	✓	(✓)
	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	(✓)	
	Reduce inequality within and among countries	(✓)	(✓)
	**Make cities and human settlements inclusive, safe, resilient and sustainable**	✓	(✓)
	**Ensure sustainable consumption and production patterns**	✓	(✓)
	**Take urgent action to combat climate change and its impacts**	✓	✓
	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	(✓)	(✓)
	**Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**	✓	✓
	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels		(✓)
	Strengthen the means of implementation and revitalise the global partnership for sustainable development	(✓)	(✓)

Source: own elaboration based on SDKP (2015). ***Bold text:*** *SDG related to energy;* (✓) *= partially relevant*

Table 1 can be explained as follows:

- SDG 1 (end poverty) is a partial driver (e.g. through increased investments in bioenergy for rural employment, and income), but also a safeguard (e.g. regarding land grabbing).
- SDG 2 (end hunger) will increase biomass for food & feed, but can also act as a safeguard due to promoting **sustainable** agriculture and improving the integration of bioenergy into agriculture (e.g. agroforestry, intercropping).
- SDG 3 (health) can be a driver for more biomass through substitution of fossil fuel for cooking and heating, and may be a safeguard for respiratory diseases due to reducing health impacts from "traditional" biomass use.
- SDG 6 (water) is a partial driver due to improved waste water treatment which implies increased supply of biogas.
- SDG 7 (sustainable energy for all) and particularly Target 7.2 "*By 2030, increase substantially the share of renewable energy in the global energy mix*" are key drivers for increasing bioenergy demand, but as they call for **sustainable** energy, they could also be safeguards.
- SDG 8 (sustainable growth and employment) could be a partial driver, especially in biomass-rich countries and rural areas seeking economic development through biomass supply and use.
- SDG 9 (sustainable industrialization) could be a partial driver, but also possible safeguard if economic development considers environmental and social issues.
- SDG 10 (reduce inequality within and among countries) could be a partial driver by increasing local biomass supply and international trade, but also possibly a safeguard if sustainability issues are considered in rural biomass development, and international trade.
- SDG 11 (sustainable cities) can be a partial driver, as it implies increased sustainable housing (using biomaterials for construction), and also a potential safeguard if cities require **sustainable** provision of biomass, e.g. through procurement rules.
- SDG 12 (sustainable consumption and production) will be a driver though increased use of biomaterials, and potentially safeguarding biomass sourcing.
- SDG 13 (combat climate change) is a driver, as biomass is (under certain conditions) a low-GHG option for energy and materials, and also a safeguard in avoiding high-carbon options (e.g. biomass from conversion of grasslands, or deforestation).
- SDG 14 (oceans and marine resources) may be both a partial driver, and a partial safeguard if aquatic biomass is developed for biomaterials, and bioenergy supply.
- SDG 15 (life on land) can be a partial driver (restoring degraded land through biomass), and also a safeguard (protecting biodiversity, reducing land degradation).
- SDG 16 (peaceful and inclusive societies) has the potential to become a partial safeguard if institutions are accountable and take into consideration biomass sustainability.
- SDG 17 (global partnerships) may imply both increased biomass use, and sustainability safeguards for biomass if e.g. GBEP's GSIs receive more attention.

Except SDG 4, all SDGs are – with more or less relevance – linked to biomass, either as drivers, or as safeguards. To analyze the SDG impact on biomass, **all** these drivers and safeguards need to be reflected in an **integrated way**.

3 The GSIs for Bioenergy and the SDGs

The GSIs give a broad scope of sustainability considerations covering all three "pillars", i.e. environment, social and economic aspects (see Table 2).

Table 2 The GBEP Sustainability Indicators for Bioenergy

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

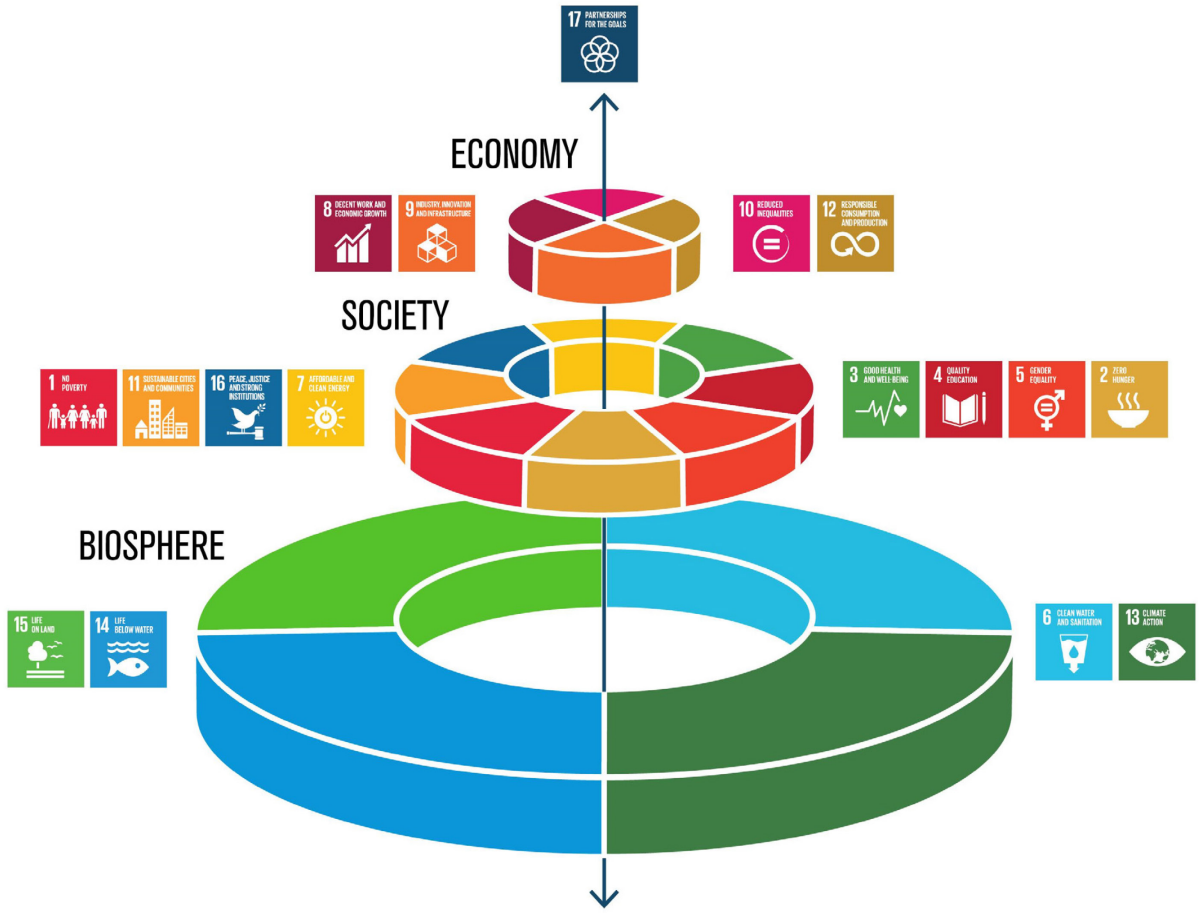
Source: GBEP (2011)

The GSIs are accompanied by descriptions of concepts, data sources and methodologies (GBEP 2011). In the following subsections, the linkages between the SDGs (and their targets and indicators) are presented for each of the three GSI pillars[7].

The SDGs, on the other hand, are not structured into specific areas or pillars of sustainability – the UN has just "listed" them, but they should be seen as an integrated total (Cutter 2015; Griggs et al. 2017; Lui et al. 2015; Nunes et al. 2016; OECD 2016; Spaiser et al. 2016).

Yet, work of the Stockholm Resilience Institute grouped the SDGs into three "levels" which are similar to the GSI "pillar" structure, as indicated in Figure 4.

Figure 4 Conceptual Structuring of the SDGs



[7] For a reverse representation, i.e. a table with the SDGs, their targets and indicators, and the related GSIs, see Annex.

Source: Stockholm Resilience Institute

The bottom "biosphere" can be seen as representing the ecological pillar (4 SDGs), while "society" and "economy" represent the social (8 SDGs) and economic (4 SDGs) pillars. The "top" SDG 17 is not to be seen as the top of a pyramid, but as transcending the structure.

The following sub-sections present the results of the **mapping of linkages** between the GSIs and SDGs (on the level of their indicators) for each of the GSI pillars.

It should be noted that there is a variety of recent literature which addresses interlinkages and tradeoffs **between** the SDGs themselves (e.g. Nerini et al. 2018; Nilsson et al. 2016; Nilsson, Griggs & Visbeck 2016).

3.1 The Tier Classification for the SDG Indicators

In addition to the linkages, the tables in the following sub-sections also show the SDG tier classification (UN-ESC 2017b):

- **Tier I:** Indicator conceptually clear, established methodology and standards available and data regularly produced by countries
- **Tier II:** Indicator conceptually clear, established methodology and standards available **but** data are **not regularly** produced by countries
- **Tier III:** Indicator for which there are **no established methodology** and standards or methodology/standards are being developed/ tested

The SDG tier concept **may be of interest** for the ongoing GBEP work on preparing a guidance document for the GSIs.

3.2 Environmental Pillar

Table 3 SDGs and the GBEP Sustainability Indicators for Bioenergy: Environmental Pillar

GSI - Environmental pillar	SDG and Target(s)	SDG Indicator(s)	Tier
1. Life-cycle GHG emissions Lifecycle greenhouse gas emissions from bioenergy production and use, as per the methodology chosen nationally or at community level, and reported using the GBEP Common Methodological Framework for GHG Lifecycle Analysis of Bioenergy 'Version One'	**Goal 13**. Take urgent action to combat climate change and its impacts **Target 13.2** Integrate climate change measures into national policies, strategies and planning	**13.2.1** Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other)	III
	Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation **Target 9.4** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all	**9.4.1** CO_2 emission per unit of value added	I

GSI - Environmental pillar	SDG and Target(s)	SDG Indicator(s)	Tier
	countries taking action in accordance with their respective capabilities		
2. Soil quality Percentage of land for which soil quality, in particular in terms of soil organic carbon, is maintained or improved out of total land on which bioenergy feedstock is cultivated or harvested	**Goal 2**. End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.4** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	**2.4.1** Proportion of agricultural area under productive and sustainable agriculture	III
	Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss **Target 15.3** By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	**15.3.1** Proportion of land that is degraded over total land area	III

GSI - Environmental pillar	SDG and Target(s)	SDG Indicator(s)	Tier
3. Harvest levels of wood resources Annual harvest of wood resources by volume and as a percentage of net growth or sustained yield, and the percentage of the annual harvest used for bioenergy	**Goal 15.** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss **Target 15.2** By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	**15.2.1** Progress towards sustainable forest management	II
4. Emissions of non-GHG air pollutants, including air toxics Emissions of non-GHG air pollutants, including air toxics, from bioenergy feedstock production, processing, transport of feedstocks, intermediate products and end products, and use; and in comparison with other energy sources	**Goal 11**. Make cities and human settlements inclusive, safe, resilient and sustainable **Target 11.6** By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	**11.6.1** Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities **11.6.2** Annual mean levels of fine particulate matter (e.g. $PM_{2.5}$ and PM_{10}) in cities (population weighted	II I
5. Water use and efficiency 5.1 Water withdrawn from nationally-determined watershed(s) for the production and processing of bioenergy feedstocks, expressed as the percentage of total actual renewable water resources (TARWR) and as the percentage of total annual water withdrawals (TAWW), disaggregated into renewable and non-renewable water sources	**Goal 6.** Ensure availability and sustainable management of water and sanitation for all **Target 6.4** By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	**6.4.1** Change in water-use efficiency over time **6.4.2** Level of water stress: freshwater withdrawal as a proportion of available freshwater resource	II I

GSI - Environmental pillar	SDG and Target(s)	SDG Indicator(s)	Tier
6. Water quality 6.1 Pollutant loadings to waterways and bodies of water attributable to fertilizer and pesticide application for bioenergy feedstock cultivation, and expressed as a percentage of pollutant loadings from total agricultural production in the watershed	**Goal 6.** Ensure availability and sustainable management of water and sanitation for all **Target 6.3** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	**6.3.1** Proportion of wastewater safely treated	II
		6.3.2 Proportion of bodies of water with good ambient water quality	III
7. Biological diversity in the landscape 7.3 Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used	**Goal 2**. End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.4** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	**2.4.1** Proportion of agricultural area under productive and sustainable agriculture	III
	Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss **Target 15.8** By 2020, introduce measures to prevent the introduction and significantly reduce	**15.8.1** Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species	III

GSI - Environmental pillar	SDG and Target(s)	SDG Indicator(s)	Tier
	the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species		
8. Land use and land-use change related to bioenergy feedstock production 8.1 Total area of land for bioenergy feedstock production, and as compared to total national surface and agricultural and managed forest land area 8.2 Percentages of bioenergy from yield increases, residues, wastes and degraded or contaminated land 8.3 Net annual rates of conversion between land-use types caused directly by bioenergy feedstock production	**Goal 15**. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss **Target 15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	**15.1.1** Forest area as a proportion of total land area **15.1.2** Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type"	I

Source: IINAS compilation

3.3 Social Pillar

Table 4 SDGs and the GBEP Sustainability Indicators for Bioenergy: Social Pillar

GSI - Social pillar	SDG and Target(s)	SDG Indicator(s)	Tier
9. Allocation and tenure of land for new bioenergy production Percentage of land – total and by land-use type – used for new bioenergy production where: • a legal instrument or domestic authority establishes title and procedures for change of title; and • the current domestic legal system and/or socially accepted practices provide due process and the established procedures are followed for determining legal title	**Goal 1.** End poverty in all its forms everywhere **Target 1.4** By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	**1.4.2** Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure	III
	Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.3** By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	**2.3.1** Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size **2.3.2** Average income of small-scale food producers, by sex and indigenous status	III

GSI - Social pillar	SDG and Target(s)	SDG Indicator(s)	Tier
10. Price and supply of a national food basket Effects of bioenergy use and domestic production on the price and supply of a food basket, which is a nationally defined collection of representative foodstuffs, including main staple crops, measured at the national, regional, and/or household level, taking into consideration: • changes in demand for foodstuffs for food, feed and fibre; • changes in the import and export of foodstuffs; • changes in agricultural production due to weather conditions; • changes in agricultural costs from petroleum and other energy prices; and the impact of price volatility and price inflation of foodstuffs on the national, regional, and/or household welfare level, as nationally determined	**Goal 1**. End poverty in all its forms everywhere **Target 1.1** By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	**1.1.1** Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)	I
	Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.1** By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round		I
	Target 2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility	**2.1.1** Prevalence of undernourishment **2.1.2** Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES) **2.c.1** Indicator of food price anomalies	II
11. Change in income Contribution of the following to change in income due to bioenergy production: 11.1 wages paid for employment in the bioenergy sector in relation to comparable sectors	**Goal 1**. End poverty in all its forms everywhere **Target 1.2** By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	**1.2.1** Proportion of population living below the national poverty line, by sex and age **1.2.2** Proportion of men, women and children of all ages living in poverty in all	I II

GSI - Social pillar	SDG and Target(s)	SDG Indicator(s)	Tier
11.2 net income from the sale, barter and/or own-consumption of bioenergy products, including feedstocks, by self-employed households/individuals		its dimensions according to national definitions	
	Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all **Target 8.5** By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	**8.5.1** Average hourly earnings of female and male employees, by occupation, age and persons with disabilities	II
		8.5.2 Unemployment rate, by sex, age and persons with disabilities	I
	Goal 10. Reduce inequality within and among countries **Target 10.1** By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	**10.1.1** Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population	I
12. Jobs in the bioenergy sector 12.1 Net job creation as a result of bioenergy production and use, total and disaggregated (if possible) as follows:	**Goal 8**. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	**8.2.1** Annual growth rate of real GDP per employed person	I

GSI - Social pillar	SDG and Target(s)	SDG Indicator(s)	Tier
o skilled/unskilled 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 o temporary/indefinite	**Target 8.2** Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors **Target 8.3** Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	**8.3.1** Proportion of informal employment in non-agriculture employment, by sex	II
13. Change in unpaid time spent by women and children collecting biomass Change in average unpaid time spent by women and children collecting biomass as a result of switching from traditional use of biomass to modern bioenergy services	**Goal 5.** Achieve gender equality and empower all women and girls **Target 5.4** Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate	**5.4.1** Proportion of time spent on unpaid domestic and care work, by sex, age and location	II
14. Bioenergy used to expand access to modern energy services 14.1 Total amount and percentage of increased access to modern energy services gained through modern bioenergy (disaggregated by bioenergy type), measured in	**Goal 7**. Ensure access to affordable, reliable, sustainable and modern energy for all **Target 7.1** By 2030, ensure universal access to affordable, reliable and modern energy services	**7.1.1** Proportion of population with access to electricity **7.1.2** Proportion of population with primary reliance on clean fuels and technology	I

GSI - Social pillar	SDG and Target(s)	SDG Indicator(s)	Tier
terms of energy and numbers of households and businesses 14.2 Total number and percentage of households and businesses using bioenergy, disaggregated into modern bioenergy and traditional use of biomass	**Target 7.2** By 2030, increase substantially the share of renewable energy in the global energy mix	**7.2.1** Renewable energy share in the total final energy consumption	
15. Change in mortality and burden of disease attributable to indoor smoke Change in mortality and burden of disease attributable to indoor smoke from solid fuel use, and changes in these as a result of the increased deployment of modern bioenergy services, including improved biomass-based cookstoves	**Goal 3**. Ensure healthy lives and promote well-being for all at all ages **Target 3.9** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	**3.9.1** Mortality rate attributed to household and ambient air pollution	I
16. Incidence of occupational injury, illness and fatalities Incidences of occupational injury, illness and fatalities in the production of bioenergy in relation to comparable sectors	**Goal 8**. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all **Target 8.8** Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	**8.8.1** Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status **8.8.2** Level of national compliance of labour rights (freedom of association and collective bargaining) based on ILO textual sources and national legislation, by sex and migrant status	I III

Source: IINAS compilation

3.4 Economic Pillar

Table 5 SDGs and the GBEP Sustainability Indicators for Bioenergy: Economic Pillar

GSI - Economic Pillar	SDG and Target(s)	SDG Indicator(s)	Tier
17. Productivity Productivity of bioenergy feedstocks by feedstock or by farm/plantation • Processing efficiencies by technology and feedstock • Amount of bioenergy end product by mass, volume or energy content per hectare per year • Production cost per unit of bioenergy	**Goal 2**. End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.3** By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment		
18. Net energy balance Energy ratio of the bioenergy value chain with comparison with other energy sources, including energy ratios of feedstock production, processing of feedstock into bioenergy, bioenergy use; and/or lifecycle analysis	**Goal 7**. Ensure access to affordable, reliable, sustainable and modern energy for all **Target 7.3** By 2030, double the global rate of improvement in energy efficiency	**7.3.1** Energy intensity measured in terms of primary energy and GDP	I
19. Gross value added Gross value added per unit of bioenergy produced and as a percentage of gross domestic product	**Goal 7**. Ensure access to affordable, reliable, sustainable and modern energy for all **Target 7.3** By 2030, double the global rate of improvement in energy efficiency	**7.3.1** Energy intensity measured in terms of primary energy and GDP	I

GSI - Economic Pillar	SDG and Target(s)	SDG Indicator(s)	Tier
	Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all **Target 8.1** Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	**8.1.1** Annual growth rate of real GDP per capita	I
	Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation **Target 9.4** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	**9.4.1** CO2 emission per unit of value added	I

GSI - Economic Pillar	SDG and Target(s)	SDG Indicator(s)	Tier
20. Change in the consumption of fossil fuels and traditional use of biomass • Substitution of fossil fuels with domestic bioenergy measured by energy content and in annual savings of convertible currency from reduced purchases of fossil fuels • Substitution of traditional use of biomass with modern domestic bioenergy measured by energy content	**Goal 12**. Ensure sustainable consumption and production patterns **Target 12.2** By 2030, achieve the sustainable management and efficient use of natural resources	**12.2.1** Material footprint, material footprint per capita, and material footprint per GDP **12.2.2** Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	III II
21. Training and re-qualification of the workforce Percentage of trained workers in the bioenergy sector out of total bioenergy workforce, and percentage of re-qualified workers out of the total number of jobs lost in the bioenergy sector	**Goal 4**. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all **Target 4.4** By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship		II
22. Energy diversity Change in diversity of total primary energy supply due to bioenergy	**Goal 7**. Ensure access to affordable, reliable, sustainable and modern energy for all **Target 7.2** By 2030, increase substantially the share of renewable energy in the global energy mix **Target 7.3** By 2030, double the global rate of improvement in energy efficiency	**7.2.1** Renewable energy share in the total final energy consumption **7.3.1** Energy intensity measured in terms of primary energy and GDP	**I**

GSI - Economic Pillar	SDG and Target(s)	SDG Indicator(s)	Tier
23. Infrastructure and logistics for distribution of bioenergy Number and capacity of routes for critical distribution systems, along with an assessment of the proportion of the bioenergy associated with each	**Goal 9**. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation **Target 9.1** Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infra-structure, to support economic development and human well-being, with a focus on affordable and equitable access for all **Target 9.4** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities		
24. Capacity and flexibility of use of bioenergy • Ratio of capacity for using bioenergy compared with actual use for each significant utilization route • Ratio of flexible capacity which can use either bioenergy or other fuel sources to total capacity	No linkage		

Source: IINAS compilation

4 Key Findings from the Mapping of Linkages between the GSIs and the SDG Indicators

The results of the analysis of linkages between the GSIs and the SDG indicators can be summarized as follows:

- **All GSIs** from the environmental and social pillars and the **majority** from the economic pillar are linked to SDGs and their targets and indicators
- In total, **23 of the 24 GSIs** are directly linked to SDGs and their targets (only exception: GSI 24 on Capacity and flexibility of use of bioenergy)
- **Many** of the GSIs from the **environment** pillar are linked to SDG indicators of **Tier III** (6 out of 14), implying that the SDG indicators will require more work
- **Few** of the GSIs from the **social** pillar are linked to SDG indicators of **Tier III** (3 out of 14), and only one GSI from the economic pillar is linked to SDG indicators of **Tier III** (1 out of 4)

The mapping exercise results **substantiate the initial hypothesis** that the GSIs are closely linked to the SDGs and their targets, and indicators, and *vice versa*[8].

It should be noted that from the GSI point of view, there is some mismatch of SDGs and their indicators, e.g. SDG 12 (on responsible consumption and production) does not address energy. This may be an opportunity to improve the SDG indicators during national implementation, and to contribute to that through GSI data (see next section).

[8] For the mapping of the linkages of the SDGs and their targets and respective indicators to the GSIs see Annex.

5 Perspectives for Applying the GSIs in the Process of National SDG Implemention

As mentioned in Section 1, the SDGs are to be **implemented nationally** by all countries – and this includes GBEP members and observers.

The results of the analysis presented in Section 2 (and the Annex) can be used to check where and to what extent the GSIs – if a country chooses to implement them – can be **supportive in terms of data** for the SDG implementation.

As more GBEP members implement the GSIs, the potential benefits from using data collected during GSI work for the SDG implementation will increase.

Yet, it is important to note that this may well also work in the opposite direction: **national SDG implementation** could be opportunity to **initiate** GSI work and **GSI work** could provide (some) data for national SDG implementation.

Due to the many linkages, there are possibilities to **share data**, and/or to **jointly develop** relevant new data sources for **both** the GSIs, and the SDG indicators[9].

As the linkages of the GSIs and the SDGs are **substantial** and may be **beneficial for both** the SDG implementation and GSI work, it is **recommended** that the **GSI Implementation Guide** should take up the SDG interlinkages, based on this paper.

Last but not least, the results indicate that **engaging in national and international activities** on implementing the SDGs to inform concerned parties about the **opportunities of GSI work and data** are relevant issues for the future work of the GBEP Task Force on Sustainability, and the GBEP Secretariat[10].

[9] Furthermore, there are many SDG indicators classified as **Tier III** linked to GSIs, especially in the environmental pillar. As these indicators will require more work to be applicable, the ongoing GBEP discussion on pragmatic approaches for measuring the GSIs (best practices etc.) could be linked to national work on the SDG indicator development, as discussed during the GBEP workshop in Bonn (see footnote 2).

[10] The GBEP Task Force on Sustainability endorsed this in its meeting in Nov 2017 in Rome, see http://www.globalbioenergy.org/fileadmin/user_upload/gbep/docs/2017_events/20th_Meeting_of_the_GBEP_Steering_Committee_1_December_2017/Conclusions_TFS.pdf

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Annex: SDGs and GBEP Indicators

Table 6 Aggregated mapping of interlinkages between the SDGs, their targets and indicators, and the GBEP Sustainability Indicators for Bioenergy

Sustainable development goals, targets and indicators				GBEP Sustainability Indicators for Bioenergy (GSI)
SDG	**Target**	**Indicator**	**Tier**	**GSI**
	1.1	1.1.1	I	10. Price and supply of a national food basket
	1.2	1.2.1 1.2.2	I II	11. Change in income
	1.4	1.4.2	III	9. Allocation and tenure of land for new bioenergy production
	2.1	2.1.1 2.1.2	I	10. Price and supply of a national food basket
	2.3	2.3.1 2.3.2	III	9. Allocation and tenure of land for new bioenergy production
	2.4	2.4.1	III	7. Biological diversity in the landscape 2. Soil quality
	2.c	2.c.1	II	10. Price and supply of a national food basket
	3.9	3.9.1	I	15. Change in mortality and burden of disease attributable to indoor smoke
	5.4	5.4.1	II	13. Change in unpaid time spent by women and children collecting biomass
	6.3	6.3.1 6.3.2	II III	6. Water quality
	6.4	6.4.1 6.4.2	II I	5. Water use and efficiency
	7.1	7.1.1 7.1.2	I	14. Bioenergy used to expand access to modern energy services
	7.2	7.2.1	I	14. Bioenergy used to expand access to modern energy services 22. Energy diversity
	7.3	7.3.1	I	19. Gross value added 22. Energy diversity
	7.a	7.a.1	III	all GBEP work
	8.1	8.1.1	I	19. Gross value added
	8.2	8.2.1	I	12. Jobs in the bioenergy sector
	8.3	8.3.1	II	12. Jobs in the bioenergy sector
	8.5	8.5.1 8.5.2	II I	11. Change in income
	8.8	8.8.1 8.8.2	I III	16. Incidence of occupational injury, illness and fatalities
	9.4	9.4.1	I	1. Lifecycle GHG emissions 19. Gross value added
	10.1	10.1.1	I	11. Change in income
	11.6	11.6.1 11.6.2	II I	4. Emissions of non-GHG air pollutants, including air toxics
	12.2	12.2.1 12.2.2	III II	20. Change in the consumption of fossil fuels and traditional use of biomass
				

Sustainable development goals, targets and indicators				GBEP Sustainability Indicators for Bioenergy (GSI)
SDG	**Target**	**Indicator**	**Tier**	**GSI**
	13.2	13.2.1	III	1. Lifecycle GHG emissions
	15.1	15.1.1 15.1.2	I	8. Land use and land-use change related to bioenergy feedstock production
	15.2	15.2.1	II	3. Harvest levels of wood resources
	15.3	15.3.1	III	2. Soil quality
	15.8	15.8.1	III	7. Biological diversity in the landscape
			I-III	GBEP work in general

Source: IINAS compilation

Table 7 Detailed mapping of interlinkages between the SDGs, their targets and indicators, and the GBEP Sustainability Indicators for Bioenergy

Sustainable development goals, targets and indicators					**GBEP Sustainability Indicators for Bioenergy (GSI)**	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
	**Goal 1. End poverty in all its forms everywhere**	1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	1.1.1 Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)	I	10. Price and supply of a national food basket	Effects of bioenergy use and domestic production on the price and supply of a food basket, which is a nationally-defined collection of representative foodstuffs, including main staple crops, measured at the national, regional, and/or household level, taking into consideration: - changes in demand for foodstuffs for food, feed, and fibre; - changes in the import and export of foodstuffs; - changes in agricultural production due to weather conditions; - changes in agricultural costs from petroleum and other energy prices; and - the impact of price volatility and price inflation of foodstuffs on the national, regional, and/or household welfare level, as nationally-determined
		1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	1.2.1 Proportion of population living below the national poverty line, by sex and age 1.2.2 Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	I	11. Change in income	Contribution of the following to change in income due to bioenergy production: 11.1 wages paid for employment in the bioenergy sector in relation to comparable sectors 11.2 net income from the sale, barter and/or own-consumption of bioenergy products, including feedstocks, by self-employed households/individuals

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
		1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.2 Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure	III	9. Allocation and tenure of land for new bioenergy production	Percentage of land – total and by land-use type – used for new bioenergy production where: - a legal instrument or domestic authority establishes title and procedures for change of title; and - the current domestic legal system and/or socially accepted practices provide due process and the established procedures are followed for determining legal title
	**Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture**	2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	2.1.1 Prevalence of undernourishment 2.1.2 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)	I	10. Price and supply of a national food basket	see above
		2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size 2.3.2 Average income of small-scale food producers, by sex and indigenous status	III	9. Allocation and tenure of land for new bioenergy production	see above
		2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	III	7. Biological diversity in the landscape + 2. Soil quality	7.3 Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used 2. Percentage of land for which soil quality, in particular in terms of soil organic carbon, is maintained or improved out of total land on which bioenergy feedstock is cultivated or harvested

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
		2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility	2.c.1 Indicator of food price anomalies	II	10. Price and supply of a national food basket	see above
	**Goal 3. Ensure healthy lives and promote well-being for all at all ages**	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	3.9.1 Mortality rate attributed to household and ambient air pollution	I	15. Change in mortality and burden of disease attributable to indoor smoke	Change in mortality and burden of disease attributable to indoor smoke from solid fuel use, and changes in these as a result of the increased deployment of modern bioenergy services, including improved biomass-based cookstoves
	**Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all**	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship		II	21. Training and re-qualification of the workforce	Percentage of trained workers in the bioenergy sector out of total bioenergy workforce, and percentage of re-qualified workers out of the total number of jobs lost in the bioenergy sector
	**Goal 5. Achieve gender equality and empower all women and girls**	5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate	5.4.1 Proportion of time spent on unpaid domestic and care work, by sex, age and location	II	13. Change in unpaid time spent by women and children collecting biomass	Change in average unpaid time spent by women and children collecting biomass as a result of switching from traditional use of biomass to modern bioenergy services

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
	**Goal 6. Ensure availability and sustainable management of water and sanitation for all**	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated 6.3.2 Proportion of bodies of water with good ambient water quality	II III	6. Water quality	6.1 Pollutant loadings to waterways and bodies of water attributable to fertilizer and pesticide application for bioenergy feedstock cultivation, and expressed as a percentage of pollutant loadings from total agricultural production in the watershed 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
		6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.1 Change in water-use efficiency over time 6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	II I	5. Water use and efficiency	5.1 Water withdrawn from nationally-determined watershed(s) for the production and processing of bioenergy feedstocks, expressed as the percentage of total actual renewable water resources (TARWR) and as the percentage of total annual water withdrawals (TAWW), disaggregated into renewable and non-renewable water sources
	**Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all**	7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	7.1.1 Proportion of population with access to electricity 7.1.2 Proportion of population with primary reliance on clean fuels and technology	I	14. Bioenergy used to expand access to modern energy services	14.1 Total amount and percentage of increased access to modern energy services gained through modern bioenergy (disaggregated by bioenergy type), measured in terms of energy and numbers of households and businesses 14.2 Total number and percentage of households and businesses using bioenergy, disaggregated into modern bioenergy and traditional use of biomass

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
		7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption	I	14 (see above) + 22. Energy diversity	see above 22 Change in diversity of total primary energy supply due to bioenergy
		7.3 By 2030, double the global rate of improvement in energy efficiency	7.3.1 Energy intensity measured in terms of primary energy and GDP	I	19. Gross value added + 22. Energy diversity	19 Gross value added per unit of bioenergy produced and as a percentage of gross domestic product 22 Change in diversity of total primary energy supply due to bioenergy
		7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology	7.a.1 International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems	III	all GBEP work	
	**Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**	8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	8.1.1 Annual growth rate of real GDP per capita	I	19. Gross value added	see above
		8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	8.2.1 Annual growth rate of real GDP per employed person	I	12. Jobs in the bioenergy sector	12.1 Net job creation as a result of bioenergy production and use, total and disaggregated (if possible) as follows: o skilled/unskilled 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 o temporary/indefinite

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
		8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	8.3.1 Proportion of informal employment in non-agriculture employment, by sex	II	12. Jobs in the bioenergy sector	see above
		8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	8.5.1 Average hourly earnings of female and male employees, by occupation, age and persons with disabilities 8.5.2 Unemployment rate, by sex, age and persons with disabilities	II I	11. Change in income	see above
		8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	8.8.1 Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status 8.8.2 Level of national compliance of labour rights (freedom of association and collective bargaining) based on ILO textual sources and national legislation, by sex and migrant status	I III	16. Incidence of occupational injury, illness and fatalities	Incidences of occupational injury, illness and fatalities in the production of bioenergy in relation to comparable sectors
	**Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation**	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	9.4.1 CO_2 emission per unit of value added	I	1 + 19	1. Lifecycle greenhouse gas emissions from bioenergy production and use, as per the methodology chosen nationally or at community level, and reported using the GBEP Common Methodological Framework for GHG Lifecycle Analysis of Bioenergy 'Version One' 19 Gross value added per unit of bioenergy produced and as a percentage of gross domestic product
	**Goal 10. Reduce inequality within and among countries**	10.1 By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	10.1.1 Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population	I	11. Change in income	*Weak linkage; possible proxy?*

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
	**Goal 11. Make cities and human settle-ments inclusive, safe, resilient and sustainable**	11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities 11.6.2 Annual mean levels of fine particulate matter (e.g. $PM_{2.5}$ and PM_{10}) in cities (population weighted)	II I	4. Emissions of non-GHG air pollutants, including air toxics	Weak linkage; possible proxy?
	**Goal 12. Ensure sustainable consumption and production patterns**	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	12.2.1 Material footprint, material footprint per capita, and material footprint per GDP 12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	III II	20. Change in the consump-tion of fossil fuels and traditional use of biomass	20.1 Substitution of fossil fuels with domestic bioenergy measured by energy content and in annual savings of convertible currency from reduced purchases of fossil fuels 20.2 Substitution of traditional use of biomass with modern domestic bioenergy measured by energy content
	**Goal 13. Take urgent action to combat climate change and its impacts**	13.2 Integrate climate change measures into national policies, strategies and planning	13.2.1 Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other)	III	1. Lifecycle GHG emissions	see above

Sustainable development goals, targets and indicators					GBEP Sustainability Indicators for Bioenergy (GSI)	
SDG		**Target**	**Indicators**	**Tier**	**GSI**	**Description**
	**Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**	15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	15.1.1 Forest area as a proportion of total land area 15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	I	8. Land use and land-use change related to bioenergy feedstock production	8.1 Total area of land for bioenergy feedstock production, and as compared to total national surface and agricultural and managed forest land area 8.2 Percentages of bioenergy from yield increases, residues, wastes and degraded or contaminated land 8.3 Net annual rates of conversion between land-use types caused directly by bioenergy feedstock production
		15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	15.2.1 Progress towards sustainable forest management	II	3. Harvest levels of wood resources	3.1 Annual harvest of wood resources by volume and as a percentage of net growth or sustained yield 3.2 Percentage of the annual harvest used for bioenergy
		15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	15.3.1 Proportion of land that is degraded over total land area	III	2. Soil quality	Percentage of land for which soil quality, in particular in terms of soil organic carbon, is maintained or improved out of total land on which bioenergy feedstock is cultivated or harvested
		15.8 By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species	15.8.1 Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species	III	7. Biological diversity in the landscape	7.2 Area and percentage of the land used for bioenergy production where nationally recognized invasive species, by risk category, are cultivated
	**Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development**			I-III	GBEP work in general	