Annals of DAAAM for 2011 & Proceedings of the 22nd International DAAAM Symposium, Volume 22, No. 1, ISSN 1726-9679
ISBN 978-3-901509-83-4, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2011
Make Harmony between Technology and Nature, and Your Mind will Fly Free as a Bird
Annals & Proceedings of DAAAM International 2011

ASSESSMENT OF SUSTAINABLE POTENTIAL OF BIOMASS

MOMETE, D[aniela] C[ristina]

Abstract: *This paper outlines the potential of biomass for a sustainable development and introduces a new comprehensive terminology for biomass. The first objective resides in clarifying the significance of biomass, presenting the advantages and disadvantages of this resources, together with several inconveniences faced by biomass. Therefore, the paper suggests actions to encompass the sustainable potential of biomass, including a new classification that ranks biomass in different vertical and horizontal categories, the main focus being the consideration of its sustainable potential. Moreover, the classification contains several safeguards depending on the quality of different classes and their complex effects on sustainable development.*

Key words: *energy economics, sustainable biomass, sustainability safeguards*

1. INTRODUCTION

The primary energy consumption in European Union (EU) reached 1,623 million tones oil equivalent in 2009 [BP, 2010]. About 80% of this energy was in the form of fossil fuels, generating concerns about resources scarcity, climate change and pollution [Momete, 2010]. The EU is gradually more dependent on imported fossil fuels, which are characterized by rising prices. Therefore, the development of renewable energy sources (RES) is of paramount importance to assure the security of energy supply of the region and also to contribute to the lowering of the energy environmental footprint [Momete, 2009]. Inside the large variety of commercially available RES, a special position is occupied by biomass. This resource witnessed a spectacular expansion in recent years [Gregg & Smith, 2010], being an economically attractive resource, with fast recovery of the investments. About 10% of the global energy demand is covered by biomass [Faaij, 2006], but the exact contribution of biomass to energy supply is unknown, due to non-commercial use and a confusing terminology. However, this rapid growth stirred a lot of concerns regarding its real potential for sustainable development. While some researches and politicians argue that biomass is the most valuable RES, others advocate that biomass is in fact another fossil fuel, with potential to compromise food supply and the environment (effects on soil quality, deforestations, threats to biodiversity, air and water pollution). The author considers that this debate is mainly fuelled by the confusion existing in defining biomass. Therefore, the next sections are concerned with clarifying terminology and suggesting a more comprehensive description of biomass, which best serves the sustainable development and not the interests of industry and investors in new bio-business.

2. BRIEF ANALYSIS OF THE SIGNIFICANCE OF BIOMASS

There is a large variety of definitions concerning biomass, depending on the legislative body or theory maker that determines a certain inconsistency in defining this resource. The term biomass is used for a large variety of products, being considered "a generic term for all forms of energy derived from the biosphere, in a non-fossil form" [Stegger at al, 2005].

The biomass has great virtues as an energy provider, but several aspects of its origin must be clarified, as they heavily influence the biomass quality. Another issue relates with the fact that biomass materials vary greatly in composition and in concentrations of some constituents, therefore in characteristics. An additional problem concerns the various conversion routes for biomass transformations into energy, in all forms: electricity, heat, and fuels. Biomass can be converted into biogas, biofuels and also solid biomass through several thermal, chemical and biochemical routes, but some of them are pollutant [Keim, 2010]. A further inconvenience resides in the fact that standardization of fuels derived from biomass is still under development, and the biomass is not yet classified according to sustainable requirements.

There are many advantages in using biomass, but also several drawbacks that hinder this resource to be sustainably used. Table 1 portrays a brief analysis of pros and cons regarding biomass, together with corrective actions to prevent the unsustainable use of this valuable resource.

Main Advantages
1.Renewable source
2.Available technology
3.Security of energy supply
4.Rural development and alleviation of poverty
5.Local value for farmers and foresters (local job creation)
6.Reduced CO_2 emissions (sustainable biomass is "carbon-neutral": it absorbs CO_2 while it grows, compensating the emissions)
Main Disadvantages
1.Competition for land between energetic cultures and food cultures
2.Large-scale biomass development have the potential to increase the prices for food crops
3.Negative effects on soil quality (salinization, water retention, ground water contamination, etc) leading to soil exhaustion
4.Biodiversity threats (economically attractive monocultures, deforestation, mainly in the case of rain forests)
5.Logistics of biomass (transport & storage shortcomings)
6.Loss of CO_2 sinks as a result of the changes in land use
Solutions to address disadvantages
1.A new definition of biomass that uses the term biomass only for agriculture & forestry residues - see section 3
2.Development of biomass classes depending on the biomass quality and their accordingly pecuniary support -see section 3
3.Development of small-scale biomass, near processing hubs
4.Development of energetic cultures mostly on degraded/marginal land
5.Well-planned crop rotation
6.Development of new, more energy efficient cultures
7.Co-generation and co-firing of biomass and coal

Tab. 1. Key constraints of biomass and corrective actions.

At present, several normative acts are defining biomass only in terms of waste and residues, while others combine the first ones with energetic cultures and also with municipal and even industrial wastes. For instance, the European Commission (EC) defines biomass as "the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste" [EC, 2003]. Theory makers of this domain distinguish two types of biomass: traditional and modern [Muller, 2009]. The first one is mainly based on wood, which is unsustainably produced and is used for cooking/heating. The second one refers to advanced systems used to burn biomass directly or to convert it into liquid fuels/gas used in stoves or engines. There is also another approach to classify biomass in different generations [Pistonesi et al., 2008]: first generation biomass: based on agricultural crops; second generation biomass: based on agricultural and forestry waste; third generation biomass: based on new technologies.

3. SUGGESTED HARMONIZED TERMINOLOGY FOR BIOMASS

A clear and comprehensive terminology is necessary which expresses only the sustainable contribution of this resource. Table 2 introduces a new terminology that classifies vertically and horizontally biomass. The vertical part assesses 4 category types, depending on their sustainability potential, while the horizontal part grades the resources accordingly to their origin, composition, properties (moisture content, calorific values, sulphur & nitrogen content, etc) and conversion routes.

Consequently, primary products resulting from agriculture and forestry should be classified under a different name, and only by-products (residues) should be considered as biomass, but only the residues that were not previously processed (like food industry residues). Moreover, the best residues considered in category A should be in the form of ecologically oriented agriculture (less fertilizers and pesticides). The new terminology must also incorporate newer facts, like photosynthesis or enzymatic hydrolysis that are not taken into consideration by current specific vocabulary.

Biomass category	Type	Sustainability safeguards
Category A Suggested label: ***biomass***	***Organic Wastes*** Agriculture & forestry wastes and residues (vegetal & animal)	Mostly obtained in the form of ecologically oriented agriculture A1, A1.1., A1.2... A2, A2.1., A2.2... →
Category B Suggested label: ***bioculture***	***Dedicated energetic cultures***	Ecologically obtained, without compromising the food production and without affecting the soil quality Cultivated on degraded/marginal land B1, B1.2...depending on sustainability →
Category C Suggested label: ***biowaste***	***Industrial and municipal wastes (biodegradable)***	Previously separately collected C1, C1.2... depending on sustainability →
Category D Suggested label: ***biotech*** ↓	***New technologies (photosynthesis, microorganisms, enzymes, etc)***	Economic & Technical disadvantages (technical barriers, expensive routes, not commercially available)

Tab. 2. Classification of biomass resources.

The residues coming from agriculture and forestry are considered first-quality biomass and are the only ones that bear this name (category A). However, several safeguards are placed through horizontal categories that consider the residues properties (from the best to the worst: A1, A1.1.., A2, A2.1..). Category D is also seen as a good quality class, but this is still under development and bears the name biotech. These two classes are considered eligible for receiving grants and funding from national/European bodies, but their support should depend on their quality. Classes B and C incorporate biocultures together with biowaste and their support in receiving European or national funding should be in accordance with their properties, conversion routes and environmental footprint (B1, B1.1.., B2, B2.1.., C1, C1.1.., C2, C2.1...).

4. CONCLUSION

All negative impacts of energy obtained from biomass cannot be avoided at all locations, but things should be clearer when a proper terminology is enforced. The use of term biomass should be reserved only to the sustainable part of this resource, that incorporates by-products resulted from agriculture and forestry. Moreover, several safeguards should be placed, depending on the quality of different classes and their complex effects on sustainability. Recent developments that threaten food crops and compromise food supply require a European harmonized terminology and legislation, together with a proper standardization of fuels derived from biomass issued by the European Committee of Standardization.

5. ACKNOWLEDGEMENTS

This paper is supported by the Sectorial Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number SOP HRD/89/1.5/S/62988.

6. REFERENCES

Faaij A. (2006). Modern biomass conversion technologies. *Mitigation and Adaptation Strategies for Global Change*, Vol. 11, (pp. 343–375)

Gregg J. & Smith S. (2010). Global and regional potential for bioenergy from agricultural and forestry residue biomass. *Mitigation and Adaptation Strategies for Global Change*, Vol. 15, (pp. 241–262)

Momete D. C. (2010). A critical analysis of the potential of renewable energy in Romania. *Annals of the Oradea University, Fascicle of Management and Technological Engineering*, Vol IX, (pp. 170-175), ISSN 1583-0691

Momete D. C. (2009). Engineering Education for Green Employment in Romania. *Annals of DAAAM for 2009 & Proceedings of the 20th International DAAAM Symposium*, ISBN 978-3-901509-70-4, ISSN 1726-9679, B. Katalinic (Ed), pp. 0097-0099, DAAAM International, Vienna

Muller A. (2009). Sustainable agriculture and the production of biomass for energy use. *Climatic Change*, Vol. 94, (pp. 319–331)

Pistonesi H, Nadal G., Bravo V., Bouille, D. (2008). *The contribution of biofuels to the sustainability of development in Latin America and the Caribbean*, United Nations, Santiago

Steger, U. Achterberg, W. & Blok, K. (2005). *Sustainable Development and Innovation in the Energy Sector*, Springer, ISBN 978-3-540-23103-5

*** (2010). BP Statistical Review of World Energy, British Petroleum, *Available from*: *www.bp.com/statisticalreview*

*** (2003). Directive 2003/30/EC, Official Journal of the European Union