

Chapter 22

A Conceptual Model for Biomass Supply Chain Sustainability

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ABSTRACT

One of the key elements of future energy generation is the switch to non-depletable resources, widely known as renewable energy sources (RES). There are many types of RES, however, but the focus of this article is on biomass products, which mainly consists of forest production (wood) and energy crops. One of the main problems of using biomass products for renewable energy production is the fact that several constraints should be imposed for both the management of forests and land. There are different aspects of optimal management of biomass products that guarantees the sustainability of the ecological systems. In this article, an analysis of the management for forest and agricultural products from energy crops is presented, demonstrating latest trends in biomass products as primal resource for renewable energy. Finally, a conceptual model for a biomass supply chain is proposed and discussed.

INTRODUCTION

Renewable energy (RE) has turned up to be a success factor for sustainable development due to the zero emissions from harmful gasses to the people and to the environment (Filippov et al., 2015). Besides the positive effects of RE on the environment and the contribution to better living conditions (through reduced harmful emissions), there is a social sign as well.

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This advantage in social aspect is linked with reduction of poverty and increase in living conditions for a large part of the population of the developing countries (Goldemberg & Coelho, 2004). Except for reduction of harmful emissions, RE is considered as a growth leverage as develops local economic systems. Anyone has access to energy consumption and production which is very important, especially for rural areas (Ellabban et al., 2014).

Modeling and analyzing a RE network is not an easy task as multiple factors regarding sustainability (Economic, Social, and Environmental) should be examined. One of the problems in designing a renewable energy network is the selection of each type of renewable energy plant to locations with resource abundance. However, taking into consideration only this fact, the solution to the renewable energy design problem may actually lead to installation of power plants to regions with high unemployment and low GDP. This problem can be overridden with Multi Criteria Decision Making (MCDM) techniques (Zografidou et al., 2016).

One of the RES forms that is available to anyone for use is biomass, which is defined as all organic material originating from plants, trees and crops, and is essentially the collection and storage of the sun's energy through photosynthesis. Except for organic matter that is considered as biomass, renewable energy can be produced from other types of RES. The diffusion of renewable energy shows a rapid development over the past years, while the discussion about the types of energy that are used for renewable energy production has been expanded.

The types of biomass that are used for energy production Recent advances in technology have contributed in the study of Although there are many types, biomass is split into two main categories: traditional and modern biomass products. Traditional biomass is produced in an unsustainable way and it is used as a non-commercial source, usually with very low efficiencies for cooking in many countries. On the contrary non-traditional biomass is sustainable and energy efficient.

Sustainability is one of the key factors of RE production which consists of the following aspects:

- Society
- Environment
- Economy

Each aspect has corresponding benefits from the use and production of RE. Societal benefits from renewable energy production may include the following:

1. Upgrading local communities;
2. Increasing regional GDP and employment rates;
3. Better life conditions and access to energy.

The environmental benefits from RE production concerns primarily the reduction of CO₂ and GHG emissions and the increase in environmental value, while the economic benefits are the increase in income and the regional development (Ellabban et al., 2014).

The use of renewable energy has gained ground over fossil fuels, as it can be seen in Figure 1. From Figure 1a, which corresponds to the renewable energy consumption in 1990, as a percentage of total final energy consumption, it can be seen a switch of consumption from developing rather than from developed countries. Almost 10 years after (Figure 1b), the picture has not changed except for some

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