

## Chapter 6

# Paving the Way towards Virtual Biorefineries

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### ABSTRACT

*Biomass nowadays gets an ever increasing importance as a substitute for fossil fuels and as a source of energy as well as of materials for chemical products. In comparison with other raw materials, biomass has distinguishing and additional production or rather clearing characteristics that have to be taken into account for sustainable and successful biomass supply chains. This chapter explores the drawbacks and opportunities of existing approaches to biomass logistics and continues with a detailed description of an advanced procurement system, which has been developed as a proof-of-concept by the authors. Procurement driven by meta-data based data acquisition will be discussed as a starting point for a variety of missing features in today's environmental information system's support for forming inter-business linkages in regional biomass networks. These ideas are further developed into a concept for a virtual biorefinery as an advanced system for an appropriate treatment of biomass concerning economical, ecological and sociological sustainability issues at the same time.*

### INTRODUCTION

The current age of fossil oil will come to an end. As yet, it might still be unclear when and moreover why this will happen, but if we are on the verge of the age of biomass, it is worth thinking about design considerations in time. Sheik Ahmed Zaki Yamani, former Minister of Oil and Mineral

Resources of Saudi Arabia, has put it this way already in the 70s:

**“The Stone Age came to an end not for a lack of stone, and the oil age will end, but not for a lack of oil.”**

The use of biomass gets an ever increasing importance: as a substitute for fossil fuels as well as a source of energy and materials for chemical

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products. This increased demand for non-food applications competes with the maintenance of crops as the most important feedstock for food and feed. Biomass is basically stored solar energy collected by plants. Captured CO<sub>2</sub> is converted to plant material during photosynthesis. Therefore, biomass covers recently produced organic materials from plants including materials from animals that have fed on plants. Biomass ranges from crop, forestry or wood processing residues, animal wastes (incl. human sewage), municipal solid waste (excl. non-organic components), food processing wastes, cultivated energy crops to short rotation forests (International Energy Agency, 2007) as well as marine crops, e.g. algae. However, biomass is not inexhaustible, as a scarce commodity it has to be exploited in a way that different basic needs are fulfilled while the full potential is completely tapped. Thus, intelligent management strategies are required for linking producers and consumers with intermediate preprocessing actors so that superior sustainability objectives are achieved. At this point, a need for information technology support arises since complex cross company concerns have to be managed, linked and optimized.

This chapter will explore the possibilities of existing approaches and continue with a detailed description of an advanced biomass procurement system, which has been developed as a proof-of-concept by the authors. These ideas are further developed into a concept for an advanced system including economical, ecological and sociological sustainability issues; reflecting visions of a virtual biorefinery from the University of Oldenburg and CUTECH-Institut GmbH.

## **BIOMASS CHARACTERISTICS**

Biomass is a very flexible and multiply usable resource. Biomass is an utmost needed and essential source of food as it has always been. The same holds true for biomass as a source of feed

not only for cattle but also for the whole wildlife. However, biomass - especially wood - is also a famous building material as it has always been. Relatively new is the use of biomass as a raw material for chemical products. Biomass also has always been an important source of energy as it still is in large proportions of the world (cf. Agbontalor, 2007). But, firewood for personal cooking and heating is not the only option for using biomass as an energy resource. Apart from producing electricity by directly firing biomass, today it is handled as a promising resource for fuel production – although not undisputed if not exploited carefully (cf. e.g. Zah et al., 2007, Davis, Anderson-Teixeira & DeLucia, 2008), as it is as a substitute for chemicals made of crude oil. Applications of biomass for energy are especially important, because it is a storable form of energy and therefore capable of providing base and peak energy. Research is still at an early stage, but there are already a lot of possibilities for new bio-based products, too.

It is the universalism in applicability that often breeds criticism and competing applications. Biomass is a scarce resource, but overall it is a symbol for life. Corn, crop, cereals are often seen as synonyms for food security, quality of life and social responsibility. Using biomass for energy conversion might be sensed as destruction or wastage of food. Energy conversion of biomass is often blamed for boosting food prices. According to the advisory board for renewable primary products (Beirat für nachwachsende Rohstoffe, 2005) of Lower Saxony, Germany, it is justifiable to convert biomass to energy (and other non-food products) if the requirements for food are met. It is in the responsibility of the biomass producers to show respectful consideration of today's generation needs before arguing with preservation of resources for future generations. Thus, it would be of an enormous advantage if biomass producers had a means to demonstrate that their mix of land use does no harm when partly producing for energy conversion.

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