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Plants as an alternative source of energy

MARIUSZ CYRANKOWSKI, JAN OSIPIUK, DAWID ADAMCZYK
Department of Mechanical Woodworking , Warsaw University of Life Sciences - SGGW

Abstract: *"Plants as an alternative source of energy"*. This paper presents the opportunities to combust energy crop for its energy content, along with the advantages and disadvantages of this type of energy source. It also analyses benefits and losses associated with the cultivation of energy crop, and its potential utilization in the power industry.

Keywords: energy crop, biomass, power industry.

INTRODUCTION

The renewable energy sector has been thriving in recent years: renewable energies have been at the core of large-scale concepts and environmentally friendly developments. This new phenomenon can be to some extent explained by the diminishing utilization options of fossil fuels, which will be exhausted sooner or later. The volume of fossil fuels still available is well documented, and it is estimated that the deposits of crude oil and coal will be exhausted within 30 and 200 years, respectively. The consumption of mineral energy resources is invariably associated with high emissions of greenhouse gases and the resulting adverse changes in the composition of atmospheric gases, which can lead to global climate changes. As a result of the greenhouse effect, temperatures have been increasing throughout the world. Temperature increase by merely 2-3^{0}C can be life-threatening to a multitude of plants and animals. It is also possible that people will have to face serious discomforts, especially in Africa and South Asia, where the area of arable land has noticeably decreased.

Outline of renewable energy sources

The contemporary world is almost entirely electricity-dependant. Electricity has been and will always be a crucial source of energy in the majority of human activities. It can have a variety of applications, most notably industrial production, transportation sector, heating, and lighting. Initially, electric energy has been produced by processing the natural resources: wood, brown coal, hard coal, crude oil, and gas. Facing the ever growing demand for electricity along with the diminishing natural resources as well as environmental and economic factors, people now have a new demanding challenge ahead. Within the last years, the focus has been on the development of the most efficient energy producing methods using renewable sources, such as solar radiation, water or the Earth's natural heat. The awareness has been changed as well, people now appreciate the highlights and benefits of this type of solutions.

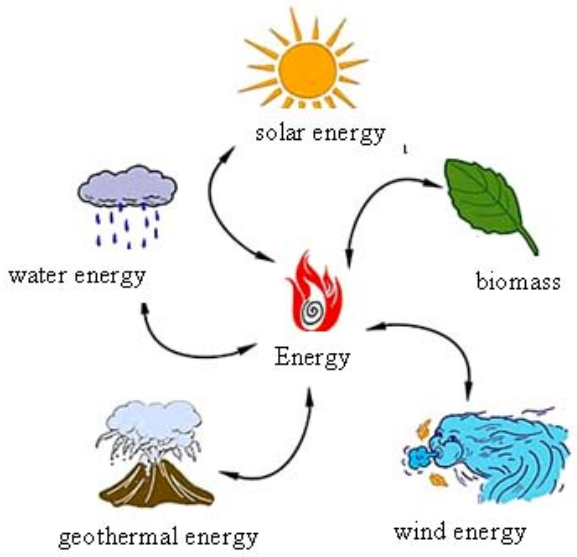

Fig. 1. Renewable sources of energy (www.ogrzewaniewpolsce.pl)

Renewable energy sources can be typically divided into non-environmentally friendly (atomic energy, deep geothermal energy, and biofuels producing nitrogen dioxides and other by-products) and environmentally friendly (energy produced of water, wind, solar radiation, shallow geothermal energy, and biomass).

YIELDING

Yielding, which is defined as the production of specific biomass volume from crop cultivated within a specific area (Table 1) depends on a variety of factors, including the cultivation climate. Short periods of insolation are typically negatively affecting the volume of biomass produced. Soil richness is another yielding aspect: the higher the content of minerals and water in soil, the higher the yields. However, energy crop can be cultivated on Class 3 and Class 4 soils, and it is even unreasonable to cultivate it on better quality soils as it has a negligible effect on yield (and better quality soils can be used to cultivate more demanding plants). Agrotechnical measures can also significantly improve yielding. (www.atmosphere.mpg.de)

Table 1: Calorific values and yielding of energy crop (Lisowski, 2010)

Name of energy plant	Average calorific value per dry mass [MJ/kg]	Dry mass per hectare of arable land [ton/ha)
Miscanthus giganteus	16.0	10.0 ÷ 25.0
Spartina pectinata (prairie cordgrass**)**	15.0	10.0 ÷ 20.0
Multiflora rose	14.4	10.0 ÷ 15.0
Giant knotweed (Fallopia sachalinensis)	17.0	10.0 ÷ 12.5
Jerusalem artichoke (Helianthus tuberosus)	16.0	10.0 ÷ 20.0
Virginia mallow (Sida hermaphrodita)	15.0	10.0 ÷ 18.0
Common osier (Salix viminalis)	18.0	10.0 ÷ 20.0

Fast growing shrubs (common osier and multiflora rose) can be considered the most appropriate for energy production purposes as they regrow quickly after being cut down. Perennials (virginia mallow, Jerusalem artichoke and giant knotweed) are less productive. Perennial grasses: miskanthus giganteus and spartina pectinata have the lowest energy potential.

Advantages and disadvantages of energy crop and its utilization potential in the power sector

Benefits associated with the cultivation of energy crop: contribution to environmental protection policy of the state. i.e. limited emissions of environmental pollutants affecting the climate, reduced environmental impact by limiting greenhouse gas emissions produced by traditional fuels, continuous and reliable supply of domestic energy medium, new jobs (especially important among rural population at high risk of unemployment), utilization of waste land, utilization of agricultural and production waste, generation of profits which are difficult to secure in conditions of over-production of crops, decentralized production of energy and improved security of energy supplies due to the increased number of energy providers.

Disadvantages associated with the cultivation of energy crop: relatively low densities of raw materials, problems related to transportation, storage and proportioning, varied humidity values make it difficult to prepare the crop for energy production purposes, lower calorific values as compared to fossil fuels, seasonal biomass availability, high risk of drastic decrease of biodiversity if monocultures of energy crop are introduced, if the biomass is contaminated with pesticides, plastic waste and chloro derivatives, carcinogenic and toxic compounds can be released in its combustion.

Utilization potential of energy crop

The biomass resources made of energy crop can be evaluated in terms of its theoretical, technical and economic potential. Chart 1 illustrates the theoretical potential, i.e. values which cannot be translated into practice since they define only the potential of raw materials or biomass. Technical potential reflects the qualitative biomass value which can be taken into account for energy production purposes if technically feasible. Economic potential has a specific economic value and involves a share of technical potential. A market potential can also be estimated as the potential of biomass available on the market and ready for use (exchange, warehouse).

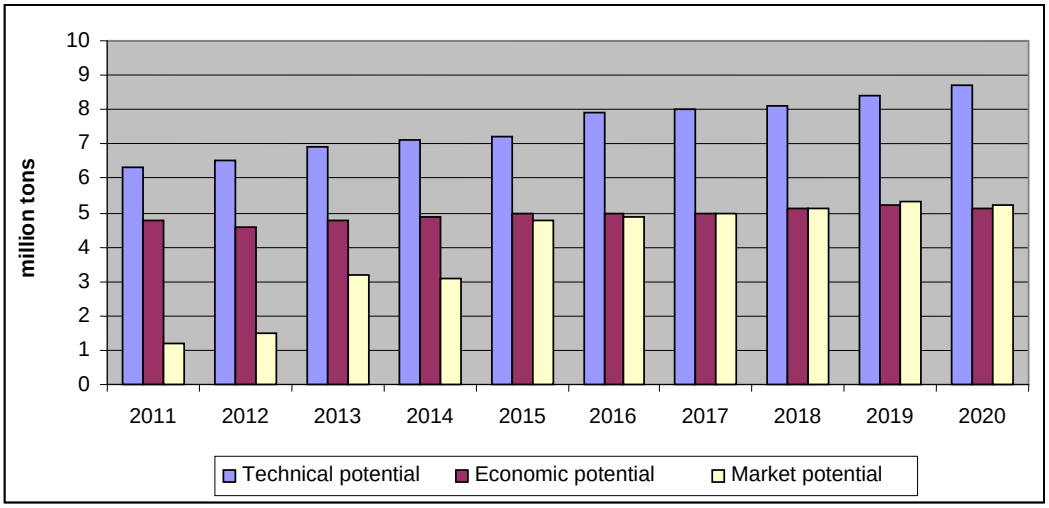

Chart 1: Estimated technical, economic and market potential of biomass for energy generation purposes (million tons]. (Gajewski, 2011)

SUMMARY

Environmental protection objectives can be pursued by the progressive implementation of energy-efficient technologies, along with the replacement of traditional energy sources with renewable ones. There are plenty of species of energy crop which can be cultivated in Poland. At present, the development of energy production methods from energy crop has reached its turning point. However, in order to be introduced on an industrial scale, a few obstacles need to be dealt with, which can change the implementation process of this particular energy source. The conceptual assumptions need to be translated into technological solutions, both on farms which cultivate energy crop, and large business entities. Numerous large power plants have already made investments in the processing and utilization of biomass. It should be therefore assumed that the benefits associated with the development of biomass production from agricultural sources currently prevail. Let us therefore be hopeful that the tendency will continue to strengthen and that the energy production from renewable sources will reach the optimum levels.

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Streszczenie:„*Plants as an alternative source of energy*”. W pracy przedstawiono możliwości przetworzenia surowców roślinnych na nośniki energii a także zalety i wady wpływające na produkcję tej energii. Omówiono korzyści jak również straty wynikające z uprawiania roślin energetycznych oraz potencjał ich wykorzystania w przemyśle energetycznym.

Corresponding authors:

Mariusz Cyrankowski, Jan Osipiuk, Dawid Adamczyk
Wood Mechanical Processing Department ,
Wood Industry Mechanisation and Automation Institute ,
e-mail: jan_osipiuk@sggw.pl
e-mail: mariusz_cyrankowski@sggw.pl
Warsaw University of Life Sciences - SGGW
02-776 Warsaw ,Nowoursynowska 159,Poland