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LIFE CYCLE ASSESSMENT OF A BIO-ELECTRICITY SYSTEM IN GREECE

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EXTENDED ABSTRACT

Energy production from biomass presents environmental benefits, since it is a renewable source and a CO_2 neutral fuel that can be used in a variety of applications (power production, transportation, etc.). However, biomass production and handling may be accompanied by negative ecological side-effects.

In this paper, a hypothetical power production system using biomass from a cardoon energy plantation, was analysed using the methodology of Life Cycle Assessment (LCA), in order to assess its environmental impacts. Fossil energy consumption, greenhouse gas emissions (CO_2, N_2O and CH_4) as well as SO_2 and NO_x emissions were assessed for the whole system on the basis of 1 kWh of electricity produced.

The methodology of LCA has been developed to evaluate the environmental burdens over the whole life cycle of a product or service taking into account all processes from raw material extraction until waste disposal. According to ISO standards for LCA (14040 – 14043) an LCA comprises of 4 interconnected phases: (1) goal and scope definition; (2) inventory analysis; (3) impact assessment and (4) interpretation.

The system under consideration was divided into three subsystems: (a) biomass production; (b) transportation and storage; (c) power production. The nominal capacity of the power plant was set to 20 MWe, and the biomass required is produced from the cultivation of a total area of 1.270 ha.

The obtained results show that the energy balance of the system is positive and 1 unit of fossil energy is required to produced 2,3 units of electricity. The biomass production stage contributes significantly to the total energy consumption and to CO_2 and SO_2 emissions, the combustion stage to the total CH_4, N_2O and NO_x emissions, while the contribution of biomass transportation and storage to all parameters considered in the study is relatively small. A sensitivity analysis shows that the efficiency of the power plant has the largest influence on the results, followed by fertilisation and the yield of the energy crop. Transportation distances had a minor influence.

Key words: Biomass, cardoon, power production, life cycle assessment.