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An economic assessment of the use of short-rotation coppice woody biomass to heat greenhouses in southern Canada

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ABSTRACT

This study explores the economic feasibility of fossil fuel substitution with biomass from short-rotation willow plantations as an option for greenhouse heating in southern Ontario, Canada. We assess the net displacement value of fossil fuel biomass combustion systems with an integrated purpose-grown biomass production enterprise. Key project parameters include greenhouse size, heating requirements, boiler capital costs and biomass establishment and management costs. Several metrics have been used to examine feasibility including net present value, internal rate of return, payback period, and the minimum or break-even prices for natural gas and heating oil for which the biomass substitution operations become financially attractive. Depending on certain key assumptions, internal rates of return ranged from 11–14% for displacing heating oil to 0–4% for displacing natural gas with woody biomass. The biomass heating projects have payback periods of 10 to >22 years for substituting heating oil and 18 to >22 years for replacing a natural gas. Sensitivity analyses indicate that fossil fuel price and efficiency of the boiler heating system are critical elements in the analyses and research on methods to improve growth and yield and reduce silviculture costs could have a large beneficial impact on the feasibility of this type of bioenergy enterprise.

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1. Introduction

Growing concerns over energy security, volatility of fossil fuel prices, global CO₂ emissions and the need to revitalize rural economies have all added to the desire and urgency of developing biomass feedstock options for bioenergy. Bioenergy plantations have been identified as an approach to offset greenhouse gases produced through the use of fossil fuels for both industrial and domestic heating purposes [1–3]. The basic idea is that woody crop biomass sequesters carbon from atmospheric CO₂ and can also be used as a carbon-

neutral substitute for fossil fuels [4]. However, while the possible use of biomass fuels as an alternative energy source is well recognized, perspectives on the costs and benefits of the fossil fuel substitution are still required. In Canada there has been growing interest in economic assessments of the attractiveness of fast-growing plantations as a source of bioenergy and fossil fuel substitute for small and medium-size regional projects [5–7].

Indeed the development of more efficient biomass energy heating systems has had appeal since the time of increasing fossil fuel prices in late 1970s. In Canada and the US the

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