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# Too hot to handle? Benefits and costs of stimulating the use of biofuels in the Swedish heating sector

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## Abstract

This paper evaluates the impact of changes in current Swedish energy taxation by analyzing a panel of approximately 150 district heating plants in Sweden. We estimate plant-specific production functions and derive the economic repercussions of changing the energy tax system. We also estimate the resulting changes of emissions of Sulfur, NO<sub>x</sub>, particulates and CO<sub>2</sub>. Our results raise the issue of whether or not the Swedish tax system needs to be complemented with additional environmental taxes, covering, say, emissions of particulates. Because the geographical variation of damages is likely to be substantial, an overall re-assessment of current regulatory schemes seems preferable. © 2001 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

The Swedish government introduced a program in 1997 for stimulating a large-scale increase of the use of biofuels.<sup>1</sup> The program includes subsidies to households and large-scale combustion plants, and comes amidst an overhaul of the whole energy taxation system. In the new energy taxation system, the objective is to harmonize energy taxes between the industrial and the heating sector. In practice, this entails a reduction of the general energy

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<sup>1</sup> In this paper, we define biofuels as fuels originating from wood products, such as residues from cuttings, wood chips, and wood pellets.

tax and the CO<sub>2</sub> tax for the heating sector. Given the current energy taxation system, the overhaul will increase the relative price of biofuels used in heating plants. This paper sheds empirical light on this issue, by estimating the impact on district heating plants of a comprehensive change in energy taxation. Using a detailed panel-data set covering the period 1989–1996, we estimate the technology for each heating plant and simulate the choice of fuel-mix for several policy packages. In addition, we estimate environmental impacts, by using detailed data on plant technologies.

The paper is structured as follows. Section 2 provides some details about the current energy taxation system and proposals to re-structure it. Section 3 presents a theoretical model of a cost-minimizing power plant. Section 4 describes the econometric specification of the model; estimation results are presented in Section 5. Simulations of the different policy packages are given in Section 6. Section 7 displays the projected emission changes. Section 8 offers concluding remarks.

## **2. Energy taxation in Sweden**

As a background for the simulation below, we begin by commenting on salient features of the current energy taxation system.<sup>2</sup>

- Fuels used for energy purposes are taxed differently depending on where they are used. Energy tax, carbon dioxide tax and sulfur tax, is charged on fossil fuels used for heating and as vehicle fuels. In addition, energy tax is charged on the consumption of electricity.
- All fuels used in electricity production, including plants that produce both electricity and heat, are exempted from the energy tax and the CO<sub>2</sub> tax. Fuels used for heating are taxed differently, depending on whether heat is produced by the industry, by district heating plants, or in combined power and heating plants.
- Peat and biofuels are exempted from both energy tax and CO<sub>2</sub> tax. Peat is subject to the sulfur tax.
- Fuels are taxed differently depending on how they are used. In general, motor fuels are charged a higher energy tax than fuels used for heating purposes.
- Fuels are taxed differently within the same area of use. The energy tax is not proportional to energy content. For instance, the energy tax on coal is only 60% of the energy tax for oil. As a consequence, the total tax on coal and oil is similar, in spite of the higher carbon content in coal per unit of energy.

The work on a reformed energy taxation system is in progress although it is known that a new system will most likely be based on a proposal made by the Green Tax Commission in 1997 (SOU, 1997). Primary use of energy products — fossil fuels, biofuels and uranium, will be taxed according to the sum of the following four components:

- A carbon dioxide tax, proportional to carbon content.
- An energy tax, proportional to energy content.
- A sulfur tax, proportional to sulfur content.

<sup>2</sup> A more comprehensive description of energy taxation in Sweden is given in Harrison and Kriström (1997), and SOU, 1997.

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