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Carbon dioxide emissions from wood fuels in Sweden 1980–2100

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ABSTRACT

It is often assumed that wood fuels are carbon neutral. This is approximately true in the very long run since the emissions from burning wood fuels are compensated by the uptake from new trees. But it is not true in the short- and the medium term due to a number of factors. This problem is analyzed in detail in this paper, where the net carbon (dioxide) effect of using wood residues in Sweden 1980–2100 is calculated. Two important implications of the program for using wood fuels are considered: (i) the decrease of carbon stored in logging residues due to a faster transformation to carbon dioxide and (ii) delayed growth of new forest generations when logging residues are removed from the forest and used as fuel. The effects of both these factors are calculated (and projected) for the period 1980–2100. The main result is that wood fuels (in the form of wood residues) emits about 60% of the carbon dioxide that would have been emitted if the corresponding amount of energy would, have been produced by oil. One policy implication of this is that emissions from wood fuels should not, as is now the practice, be ignored and by definition equaled to zero, in national and international statistics of green house gas emissions.

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[1] The founder and former Editor-in-Chief, professor Sören Wibe, tradegically passed away in December 2010. He had a more or less finished manuscript, which he intended to submit for publication. We have now decided to publish the manuscript in the Journal of Forest Economics. The reason for publishing is not only because it is written by the founder of the Journal, but mainly because it raises an important issue and contributes to the literature in the area. The article has been reviewed according to our guidelines, and the changes made from the submitted manuscript are minor editorial changes.

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Introduction

Since about 30 years, wood fuels in the form of logging residues are an important ingredient in Swedish energy production. Their increasing share is primarily due to two factors – the increasing oil price[2] and a change in taxes that favor biofuels in general.[3] Both these factors can be reduced to one in an economic analysis: a falling price of wood fuels relative to other forms of energy, primarily fossil fuels.

The main reason for subsidizing wood fuels is that they are seen as an essential part of the "green policy shift" of the energy system. It is usually assumed that all forms of biofuels are renewable and carbon neutral, so that switching from fossil fuels to biofuels would mean both a transition to a sustainable energy system and substantial reductions in greenhouse gas emissions.

The purpose of this study is to examine in more detail the relationship between the use of wood fuel and carbon emissions. The analysis is limited to only a segment of the wood fuel market, namely fuels from wood residues and more specifically branches and tops that are "left over" after logging.[4] Using these residues is now a major part of the energy policy in Sweden (and elsewhere). The main aim of this work is to estimate the net carbon dioxide effect of this policy.

Wood fuels and carbon neutrality

There are many relations between the use of wood as energy source and carbon emissions. In this paper we shall concentrate on two: the "storage effect" and the "growth effect".

The storage effect

It is obvious that biofuels are renewable in the long run: when a tree or another crop is harvested, a new tree, or a new crop, is usually growing up in its place. But this does not imply that the use of wood fuels is without effect on the carbon dioxide balance in the atmosphere. There is a time dimension that also must be taken into account.[5] Trees can be seen as a store of carbon on earth and when trees are logged, some parts remain on the ground in the form of logging residues, branches, tops and root systems. This store will eventually decay: some of the carbon will be stored in the soil, while the bulk will successively be transformed to the atmosphere in the form of carbon dioxide.

When wood residues are used as an energy source, two things change. Firstly, there is no transfer of coal to the soil and, secondly, the transformation to atmospheric carbon dioxide will occur more quickly compared with the case where the coal stayed tied up in logging residues. Both these factors will reduce the stock of carbon grounded on earth and increase the amount of carbon dioxide in the atmosphere.

The size of this "storage effect" is significant. There are approximately 170 million tons (Mt) of carbon presently stored in logging residues in Sweden.[6] This amounts to approximately 635 Mt of CO_2, or about 13 years of carbon dioxide emissions from fossil fuels in Sweden.[7] If all residues were to be used for energy generation this stock of carbon would eventually disappear, meaning that 170 Mt of coal were moved from the ground to the atmosphere.[8] Accordingly, the policy for using wood residues for energy should be considered when analyzing net emissions of green house gases.

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[2] In real terms, the price has nearly doubled since 1990.

[3] Wood fuels are for instance exempt from both energy and carbon tax.

[4] It should be noted that we do not include stumps and root system in our calculations since these residues (at least until now) constitute only a small part of the overall use of wood fuels.

[5] For an early analysis of this, see Wibe (1990). For the case of ethanol, see also Wibe (2010).

[6] Assuming annual fellings of 70 million m^3 and an average storage time of 15 years.

[7] Carbon dioxide emissions from fossil fuel in Sweden amount to about 50 Mt annually.

[8] This is a simplification since only 40–50% of the carbon dioxide that is emitted leads to a permanent increase in the atmosphere. The rest is absorbed by the sea or land biomass.

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