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Is Wood Biomass Electric Generation Renewable and Carbon Neutral Energy?

The development of renewable energy resources has become an increasingly important part of our nation's and states' current energy strategies. Most states have mandated that electric utilities obtain an increasing share of their electric supply from renewable sources. Federal and state governments have provided significant subsidies to those who develop new renewable energy resources, and energy firms are enthusiastically responding to those subsidies.

There are several reasons for this focus, some old and some new. The older reasons date back several decades to our first dramatic realization of the consequences of relying on foreign oil supplies that were controlled by people who were not particularly friendly towards us. In addition, the environmental costs associated with coal- and uranium-fired electric generators and the production of the fuel for them were seen as major drawbacks of conventional sources of electricity. More recently we have worried about depleting domestic and international sources of relatively cheap fossil fuels. We have contemplated the approach or passage of the time of "peak" oil or natural gas, or, even "peak coal" and wondered what we would substitute for them. Finally, there has been increasing concern about greenhouse gas emissions and climate stability that has led us to focus on alternative low-carbon energy sources to replace our reliance on extracting, burning, and releasing the ancient carbon contained in fossil fuels.

At least conceptually, our forests can be looked upon as a significant renewable energy resource. The trees, after all, are created from sunlight, water, and the carbon dioxide taken from the atmosphere. When we harvest and burn a tree, we are releasing that stored carbon, but if the land base from which we harvested the tree is not damaged, it may be able to grow back the same type of trees, thus removing from the atmosphere the same amount of carbon that the burning released. Over the whole cycle of harvest and re-growth, the process could be carbon neutral, neither adding nor subtracting carbon from the atmosphere. In addition it could be renewable as long as we are not damaging the productivity of the forestland. Finally, it can be a homegrown energy source available to us in any of our many forested regions or, even, wherever soils and climate could support the growing of trees.

This conceptual argument about the renewable, low-carbon nature of using trees as an energy source, however, can unwind at several points. As over a dozen forest and climate scientists pointed out in an article in ***Science*** magazine last October, this argument ignores the impact of the change in land use on carbon balance when trees are harvested[1]. A forest that had been storing carbon in both the growing trees and in the soil supporting the forest ecosystem can be seriously disturbed when many or all of its trees are removed. In the process of harvesting the trees, the soil and other plants are likely to be damaged with accompanying carbon releases. Then the trees are burned releasing substantial amounts of carbon. What then happens to the forestland will vary depending on how carefully the land is managed. In any case, it will be decades in warm and wet climates before new growth recaptures the released carbon. In colder and dryer climates, that could take close to a century. If the land is damaged as a result of the harvest or changes in micro-climate or climate change itself makes re-growth difficult, there may be a net loss in carbon for a long time to come.

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[1] Timothy D. Searchinger et al, ***Science,*** 23 October 2009, Vol. 326, No. 5952, pp. 527-528.

If we are harvesting trees on a massive scale to replace coal as a fuel, we could face a large-scale deforestation of the landscape, creating a huge carbon debt that would add considerably to the accumulation of greenhouse gases in the atmosphere for many decades. That is the opposite of what we need to be trying to do.

In the future, in warm, wet climates, trees could be grown much faster, almost like a field crop, especially if genetically modified trees are used. This reduces the time lag between the harvest of the tree, the release of the carbon, and the re-capture of the carbon by the rapidly growing trees. To the extent that abandoned farmland is used for this purpose, it also does not involve the removal and burning of existing trees that are storing carbon. Unfortunately some of these high, quick, yield forestry methods make heavy use of fossil fuel-based fertilizers, pesticides, and herbicides. Then there is also the threat to our natural forest of genetically modified trees escaping their plantations.

For slower growing natural forests, the consumption of fossil fuels by the transportation system that is needed to collect trees from across a large region adds to the carbon emissions. Because the combustion energy in wood is less dense than the energy in coal or natural gas and because it is more difficult to use the combustion energy of wood, much higher volumes of wood are required to produce electricity than would be needed from fossil fuels. This adds to the transportation costs and to the release of carbon. These problems can be partly solved by converting the wood into more dense forms such as pellets before it is shipped to electric generators. But those processes requires heat, reducing even further the net efficiency with which useful energy is recovered from the wood and damaging the carbon balance even more.

The conceptual appeal of growing trees to provide us with a renewable, low carbon energy supply remains. But careful analysis and regulation will be required to realize that possibility. A rush to mine our forests for energy driven by unwise subsidies and mandates could lead to an outcome that is neither renewable nor carbon neutral and our forested landscapes and climate will be all the worse for it.