Myth of Carbon Neutrality of Biomass

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The *belief* that burning biomass is carbon neutral is based upon several misconceptions and incomplete analysis. Simply stated this assumption is based on the following logic. Burning plant material releases carbon dioxide into the atmosphere, but an equal amount of carbon dioxide is removed from the atmosphere when a new plant grows to replace it.

As I will explain, however, this assumption is incorrect – particularly for forest derived biomass – where burning it for electricity production is far from carbon neutral.

- First, the carbon dioxide released per unit of heat produced during combustion is greater for woody biomass than for coal. This is empirically verified chemistry. When woody biomass is used solely or in combination with coal to produce electricity, the efficiency of electricity production is lower than coal. Hence, the amount of carbon dioxide released per unit of electricity produced by woody biomass is typically *50% greater than coal*.
- Second, burning of wood takes only a few minutes, but the uptake of carbon dioxide by new trees takes decades. Hence there is always more carbon dioxide in the atmosphere when woody biomass is burned than if the tree had been left in place. Only if the tree grew back instantly would this part of the energy cycle be carbon neutral.
- Third, any future benefit of carbon dioxide uptake must be discounted relative to the immediate release of carbon dioxide upon combustion. Using a 5% annual discount rate for the regrowth is worth only half the offset value of growth in year one by the fourteenth year.

- Fourth, in no policy case is there an enforceable or verifiable requirement that trees be planted that would absorb carbon equal to that released through combustion.
- Fifth, no provision is made for the likelihood of diminished biomass regrowth that may occur from fire, insect damage, drought or premature removal for alternative development projects. Massive forest losses are now occurring in North America from all of these causes.
- Sixth, it is often stated that if the forest is managed "sustainably" so that the amount of carbon in the forest is constant, then the emissions from biomass burning are carbon neutral. While it is possible to maintain a constant amount of carbon in the forest by burning trees at the growth replacement rate of the total forest, there is always more carbon dioxide in the atmosphere than there would have been had the trees not burned.
- Seventh, it is often claimed that woody biomass only uses scraps, waste wood, thinnings and wood that is not suitable for timber purposes. The truth is that there is surprisingly little of such wood, and it is difficult and expensive to gather and transport. In practice woody biomass utilizes many whole trees to produce pellets.
- Eighth, a common argument is that forest "waste" material would decay in any case, and would release carbon dioxide in the process. Again this process is much slower than instant combustion, and adds some carbon to soils as well as releasing carbon dioxide to the atmosphere.
- Ninth, The use of fossil fuel process energy to cut, chip, pelletize, dry and transport the wood pellets to their combustion site is estimated to account for 15-20% of the embedded biomass energy, and must be be accounted for.
- Tenth, the baseline of carbon in preexisting living plants and soils that is displaced by biomass production needs to be accounted for and can require decades to a century or more to be replicated during biomass use.

Renewable energy is defined by IPCC as "…any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or

exceeds its rate of use." Biomass, however is a high carbon emitting renewable source that can be collected and burned at a more rapid rate than it is replaced.

The European Union including the United Kingdom counts biomass used for electric power as carbon neutral *by definition.* This means that biomass is counted on the same basis as solar or wind, which clearly are low carbon sources of energy. This is not only incorrect, but ironic given that developing countries that use wood for fuel that leads to deforestation and forest degradation are counted as contributing to climate change, while Europe and most states in the U.S. count emissions form "modern biofuels" as carbon neutral.

Furthermore current EU rules for biomass do not follow IPCC accounting procedures that require that carbon dioxide released from biomass combustion must be accounted for on a global basis either when combustion occurs as energy production just as fossil fuels are, or if that is not done, they must be accounted for as land use changes. If the EU counts the carbon emissions of biomass fuels as zero when burned for a fuel, then the supplier must count them as emissions from land use change. Often that is another country, but in either case, the global atmosphere accounts for them as emissions.

It is also interesting to compare the relative efficiency of the conversion of solar energy through photosynthesis to electricity by combustion of biomass, with direct conversion of solar energy into electricity by photovoltaic panels. Photosynthesis is inherently inefficient. Most estimates of photosynthetic efficiency of a standing grove of trees are less than 1%. Using that figure and a maximum conversion to electricity by combustion of woody biomass of 25%, gives a net conversion efficiency of about 0.25%. Solar PV panels today are commercially available that are 20% efficient providing an advantage per unit area of a factor of 80.

For the reasons given above, the U.S. Environmental Protection Agency in its recent Clean Power Plant Rule does not sanction woody biomass as a carbon neutral substitute for coal in meeting the low carbon standards for power plants.

To address climate change, any carbon accounting system that is used to implement policies that are directed towards reducing concentrations of heat trapping gases in the atmosphere must conform to the accounting system that is actually used by the atmosphere. Otherwise the consequences for climate change will be severe. Since over half of EU renewable energy is from biomass, the claims made of meeting carbon reduction targets are questionable without proper accounting.

Appendix 1. A simple model

To understand the system dynamics of biomass, consider the following simple model.

A savings account contains £100 and there is £1000 in the economy. The money must either be in the savings account or in the economy.

Case 1. Each month £10 are withdrawn and immediately replaced. The amounts in the savings account and in the economy remain at £100 and £1000 respectively. This is a *savings neutral* situation.

Case 2. The account earns £1 in interest each year so at the end of the year the account is £11 and the economy has £999. Wealth has been transferred from the general economy to the savings holder.

Case 3. At the beginning of the month £10 is removed from the account so that the balance is now £90 and there is £1010 in the economy. The account now accrues interest at the rate of £1 per year. So that by the end of ten years, the amount in the account is

again £100 and the amount in the economy is £1000. Note that for most of that time, there is more money in the economy than in the savings account.

Case 4. At the beginning of the process, £10 are removed so that there are £90 in the account and £1010 in the economy. Now if each month £10 are added and then removed by the end of the month, the amount in the account remains at £90, which is constant yet lower than before, and the amount in the economy remains constant, but is higher at £1010.

If the savings account is replaced by a forest and the economy by the atmosphere, it is clear that removing any carbon from the forest faster than its replacement time under any scenario places more carbon in the atmosphere than would be the case if the forest were at some steady state without being burned for fuel. Using wood from trees for buildings and other wood products stores carbon for long periods of time, while removing additional carbon from the atmosphere.