INSIGHTS

PERSPECTIVES

CLIMATE

Are wood pellets a green fuel?

A return to firewood is bad for forests and for the climate

By **William H. Schlesinger**

James Watt's steam engine vaulted coal to its major role as a fuel for the Industrial Revolution. Today, about 40% of the world's electricity is generated in coal-fired power plants, consuming more than 80% of the coal mined each year. Because combustion of coal produces carbon dioxide (CO_2) and other air pollutants, efforts to combat climate change have now turned to seeking alternatives to coal. Natural gas is cleaner and less expensive but, like coal, returns fossil carbon to the atmosphere. Recently, attention has focused on woody biomass—a return to firewood—to generate electricity. Trees remove CO_2 from the atmosphere, and burning wood returns it. But recent evidence shows that the use of wood as fuel is likely to result in net CO_2 emissions and may endanger forest biodiversity.

In recent years, ~7 million metric tons of wood pellets per year have been shipped from the United States to the European Union (EU), where biomass fuels have been declared carbon neutral and are thus considered to count toward fulfilling the commitments of the Paris Agreement. The EU aims to generate 20% of its electricity by 2020 using renewable sources, including burning woody biomass. In part to revive a languishing forest products industry, the U.S. Congress may also declare wood a carbon-neutral fuel. Despite its withdrawal from the Paris Agreement, the United States may see a few utilities switch from coal to wood, which costs roughly the same as natural gas. The switch could be further incentivized with a carbon tax on fossil carbon (*1*).

Cutting trees for fuel is antithetical to the important role that forests play as a sink for CO_2 that might otherwise accumulate in the atmosphere. Each year, an estimated 31% of the CO_2 emitted from human activities is stored in forests (*2*). However, managed forests store less carbon than their

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Young loblolly pines are harvested in the southeastern United States.

native counterparts (*3*), and harvesting of native forests will therefore be a source of, not a sink for, atmospheric CO_2. Furthermore, wood contains less energy than coal, and wood burning thus generates higher CO_2 emissions per kilowatt of electricity. The CO_2 emissions from burning wood offset CO_2 that might otherwise be emitted from fossil-fuel combustion (*4*, *5*), but full carbon accounting must also consider how long it takes to restore the carbon pool of forested land that has been converted to atmospheric CO_2 (*6*).

The large-scale abandonment of agricultural activities during the Great Depression (1929 to 1939) led to a rapid expansion of mostly natural forests across the southeastern United States. Later, these natural stands were replaced by plantations of loblolly and slash pine, which were the favorites of the forest products industry because they grow well in the warm, wet climate of the Southeast (see the photo). Loblolly pine plantations achieve a maximum biomass of 125 metric tons per hectare in about 40 years (*7*). But because this species achieves its maximum rate of biomass accrual in about 20 years, rotations are usually kept short to maintain the fastest carbon uptake possible. Thirty-four operating and proposed wood-pellet plants dot the landscape of the Southeast, each anticipated to receive logs from the region within an 80-km radius. Maine and the Canadian Maritime provinces also eye the potential for wood pellets to revitalize their forest products industries; most of this wood would derive from natural forests and not plantations.

It is not only the burning of wood that adds CO_2 to the atmosphere. Making wood pellets and shipping them to Europe can account for about 25% of the total carbon emitted to the atmosphere from the use of wood pellets in European power plants (*8*). Carbon neutrality for wood is only achieved if the areas that are harvested are allowed to regrow such that they store more than their original biomass. Furthermore, the benefits of wood power must be discounted by the loss of the carbon sequestration that would have occurred in the original forests if they had not been harvested (*6*).

Although the carbon uptake by southeastern forests is greatest at about 20 years, regrowing stands continue to have lower biomass than unharvested stands for 40 to 100 years (*9*, *10*). Rotation lengths of less than 40 years seem certain to transfer carbon from biomass to CO_2 in the atmosphere. By contrast, nonwoody biomass fuels such as switchgrass or silvergrass (*Miscanthus*) regrow within a year, balancing the emissions from their combustion to their subsequent uptake of CO_2 through photosynthesis. With wood, there is the assumption—but no guarantee—that new trees will be planted and will persist long enough to pay back the carbon debt created by burning the previous stands. If that carbon stock is not restored, burning wood may actually emit more CO_2 to the atmosphere than burning coal (*10*).

Much of the argument about the carbon neutrality of wood power centers on the time frame of analysis. Because CO_2 persists for many decades in the atmosphere, some scientists argue that CO_2 emitted to the atmosphere does not contribute substantially to global warming in intervals less than a century (*11*). Others hold that all CO_2 molecules in the atmosphere exert the same effect and that plantation rotations of less than 20 years make a substantial net contribution to global warming. Ocko *et al.* (*12*) argue that the impacts on warming should always be reported for both 20- and 100-year periods, so that policy-makers can understand the net CO_2 emissions that are associated with the time horizon of different policy options. Full international participation is paramount; it makes no sense to have Europeans embracing wood pellets as carbon neutral, thereby overlooking the CO_2 emitted during shipment and the losses of carbon stock from forests harvested outside Europe. This is another example of exporting CO_2 emissions beyond the border (*13*).

Many environmental economists believe that the increased value of forests for wood-pellet production will ensure that more forests are planted (*14*); when trees have little or no value, the landscape is more likely to succumb to commercial or residential development. But in the southeastern United States, these forests are most likely to be pine plantations, which are of limited value for the preservation of its rich regional biodiversity. Furthermore, increased demand for wood pellets can raise the price of raw wood, diverting harvest to old-growth forests, which are important areas for biodiversity.

Biodiversity losses in the southeastern United States mostly result from land clearing (*15*), and agricultural clearing during the past two centuries likely already had great impacts on biodiversity. Following agricultural abandonment in the early 20th century, forests are now more widespread but are mostly pine plantations with low biomass and low diversity. Ultimately, the question is what kinds of forests are most desirable for the future. Unless forests are guaranteed to regrow to carbon parity, production of wood pellets for fuel is likely to result in more CO_2 in the atmosphere and fewer species than there are today. ■

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10.1126/science.aat2305

Science

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Science **359** (6382), 1328-1329.
DOI: 10.1126/science.aat2305