Wood as a material for conservation of energy

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Abstract

Concerns about global climate change and the potentially adverse consequences of rising temperatures emphasize the importance of conserving fossil fuel energy. Measurements at the Mauna Loa observatory in Hawaii show that atmospheric carbon dioxide concentration has increased steadily since 1950 (when record-keeping began). This accumulation of carbon in the atmosphere may enhance the greenhouse effect. Excessive carbon flux has resulted from the burning of fossil fuels and the decline of forestry on tropical forestlands, with the excess carbon accumulating in the atmosphere rather than being recycled. Wood used as a material sequesters carbon that might otherwise contribute to atmospheric carbon accumulation and is less energy intensive than competing materials. Wood used as a renewable fuel source could supply up to 10 percent of our future energy needs if we optimize growth, harvesting, and utilization efforts. In addition, wood can be recycled, which enhances the benefits of conservation and sequestration.

Introduction

Measurements at Mauna Loa observatory in Hawaii show that atmospheric carbon dioxide concentration in the atmosphere has increased steadily since 1950 (Fig. 1). Along with the increased atmospheric carbon, the average surface air temperature of the earth has also risen (Fig. 2). There is still some controversy over whether increased temperatures and ultimate undesirable global warming are directly related to increased atmospheric greenhouse gases such as carbon dioxide. However, many researchers feel there is a correlation, and build-up of various greenhouse gases beyond base levels is undesirable for other reasons in addition to the temperature-increasing effect.

Our forests can seine in four capacities to reduce the amount of carbon dioxide in the atmosphere:

1. The forests are a natural carbon sink and can absorb carbon dioxide in the atmosphere.
2. The utilization of forests can tie up carbon in consumer products for long periods of time.
3. Using timber instead of steel, concrete, aluminum, plastics, and other energy-intensive materials reduces the fossil fuel requirements and CO_2 production during materials extraction, processing, and use.
4. The forests can provide us with heating fuel.

This paper will focus on approaches 2 and 3 to reduce the adverse effects of increased atmospheric carbon levels.

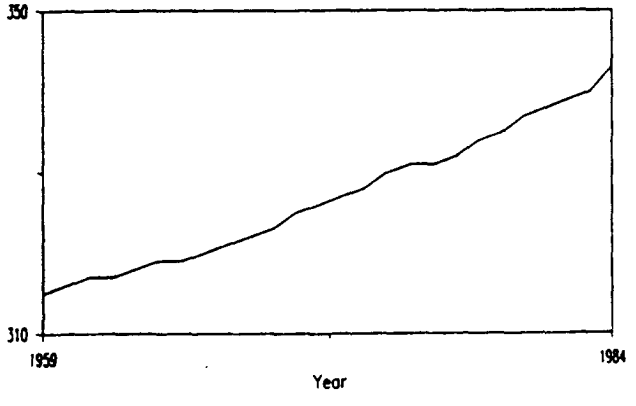

Figure 1. — Change in atmospheric CO_2 Mauna Loa, Hawaii.

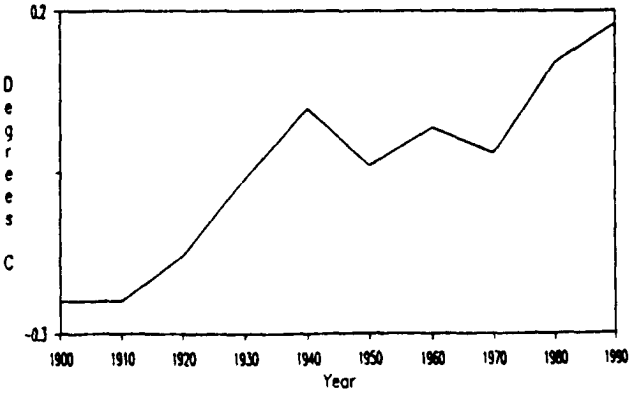

Figure 2. — Global surface air temperature.

Conservation of energy through wood use as a construction material

Forestry and forest products is the fourth m important sector of the United States economy. The construction industry, particularly housing, makes up the largest segment of the forest products market. Building on this market will provide an economic boost as well as an opportunity to enhance energy conservation through use of the renewable, less energy-consumptive wood resource. In addition, increased use of wood in place of concrete avoids the release of CO_2 during concrete manufacture.

There is an excellent opportunity for energy conservation in residential frame construction to significantly extend energy benefits from the use of wood as a basic material. Research in construction of tighter but well-ventilated houses, application of passive solar heating principles, heating with wood fuel, shade tree plantings to reduce cooling loads, and urban or community forest plantings would pay off handsomely in establishing technology for reducing fossil fuel use.

Wood preservation to extend service life and length of carbon sequestration

In order for wood to provide service durability fully equivalent to materials that are not susceptible to decay and insect attack, wood must be treated or otherwise protected in exposed locations. Extension of service life also means longer sequestration of carbon and less energy consumption in supply of replacement materials.

We will always need affordable, safe, durable housing and other wood construction. Chemical treatments will continue to be needed to protect some wood products, but with increased emphasis on environmental safety, there is less dependency on broad-spectrum pesticides. Research must be implemented to achieve more economical protection with less reliance on chemical intervention. Approaches include processing schedules for raw wood that provide less opportunity for biological deterioration, engineering options for protecting products and houses without pesticides, potentials for biocontrol such as using antagonists, antibiotics, or ecosystem manipulation, and treatments which could modify the chemical structure of wood cell walls so that microbial enzymes can't degrade them.

Increased energy savings in wood products through research

Research in product processing and application can lead to increased energy efficiencies in the use of wood products. For example, the Forest Products Laboratory has conceived and developed a unique processing means for producing superior paperboard from low value furnishes, at higher yield, and with reduced use of energy. An analysis of process economics by Dr. Peter Ince shows that total process energy required for press-drying of high-yield linerboard would be less than 61 percent of that required for conventional processing. Estimated fuel costs for the press-dry process would be 38 percent of those for the conventional process—although electrical costs would be 11 percent greater. Total process energy required for linerboard production is reduced from 24.6 to 14.9 gigajoules per metric ton. However press-drying requires the development of new drying machinery for the industry. Despite the significant advantages cited for the press-dry process, it has not been put into practice by the industry.

Recycling

For materials to be used effectively for energy conservation, besides being low-energy intensive for first-time use and durable in service, it is important that they be readily recyclable. Wood and paper products are among the most popular materials for recycling, and recycling rates for these products are increasing. When recycling wood and paper after service life of these products has been completed, they can usually be used as fuel for conservation of fossil fuels.

Conclusions

Future demand for wood will increase because the use of wood can help solve environmental problems. However, the availability of wood may decrease because of the need to maintain species habitat and set-asides for recreation. Because carbon is stored in forest soil, litter, under-story, and trees, we must protect and manage entire ecosystems to produce trees in perpetuity. In the United States, forestland makes up a significant portion of our total land area. Sustainable managed forestlands can provide the wood that will help us conserve fossil fuel energy and nonrenewable materials.

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