

Climate Change and Carbon Sequestration*

Environmental Effects of Woody Biomass:

Diomy S. Zamora¹, Charles R. Blinn², Eric L. Taylor³, Gary J. Wyatt⁴

Background

The use of biomass for energy is becoming increasingly important as a resource to reduce greenhouse gas (GHG) emissions into our atmosphere (air) by replacing fossil fuels such as coal. Our atmosphere sustains life on Earth, maintains warmth, and shields the Earth from harmful radiation emitted by the Sun. With the advent of the Industrial Revolution, the mixture of gases and particles in our atmosphere began to change. While the primary gases in our atmosphere are nitrogen (N₂) and oxygen (O₂), the greenhouse gases water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (NO_x), and ozone act like a heat blanket and are important in insulating Earth's surface.

The burning of fossil fuels has considerably increased atmospheric carbon and other GHGs since the beginning of the Industrial Revolution. When burned, coal and other fossil fuels release CO₂ and other gases into the Earth's atmosphere where they trap and reflect more heat than would normally occur, thus, affecting climate change. Because this carbon came from fossilized storage (carbon that was produced and stored millions of years ago), it represents a net addition into the atmosphere and more than can be sequestered (stored) by today's plants, soils, and oceans.

The buildup of human-caused GHGs in our atmosphere from burning fossil fuels can be mitigated through the process of carbon sequestration, or removing CO₂ from the atmosphere into long-lived carbon pools such as trees. The process of photosynthesis combines atmospheric CO₂ with water, releasing oxygen into the atmosphere and incorporating the carbon atoms into the plant cells. As a result, this carbon neutral process can help displace CO₂ emissions from burning fossil fuels (Figure 1). Finding sustainable ways to meet growing energy needs while reducing GHG emissions is one way to address the threat of climate change. While wind and solar power are increasing in popularity and prevalence, so is biomass. Versatile enough to provide heat, power, electricity, transportation fuels, and other products, woody biomass can be used to produce energy on a larger scale than solar and wind, in many cases. It is probable that a successful and sustainable short- and mid-term response to the threat of climate change will be comprised of a suite of renewable energy options that includes woody biomass.

Benefits

Woody biomass emits less GHG emissions than fossil fuels and if sources are replanted on a sustainable basis, the process of using woody biomass is essentially carbon-neutral (Figures 1). For every British thermal unit (Btu) produced by cellulosic ethanol from wood, grasses, or the non-edible parts of plants rather than gasoline, there is a total lifecycle greenhouse gas reduction of 90.9% (Malmsheimer et al., 2008). About 40 million dry tons of logging residues are available for bioenergy production in the United States annually. Utilizing these residues would displace about 17.6 million tons of carbon annually, or 3% of the total current

¹ Extension Educator/Associate Extension Professor, zamor015@umn.edu

² Professor, cblinn@umn.edu

³ Associate Professor and Extension Specialist, etaylor@tamu.edu

⁴ Extension Educator/Extension Professor, wyatt@umn.edu

* Some of this content is derived from C.D. Foster, J. Gan, and C. Mayfield, 2007. Environmental Benefits of Woody Biomass Utilization. In: Hubbard W, Biles L, Mayfield C, Ashton S (eds). Sustainable Forestry for Bioenergy and Bio-based Products: Trainer Curriculum Notebook. Athens, GA: Southern Forest Research Partnership, Inc.

carbon emissions from the electrical sector (Gan and Smith 2006). The cost of using logging residues for carbon displacement is \$60 to \$70/ton, considerably less than other mitigation options of \$83 to \$164/ton (IPCC, 2001).

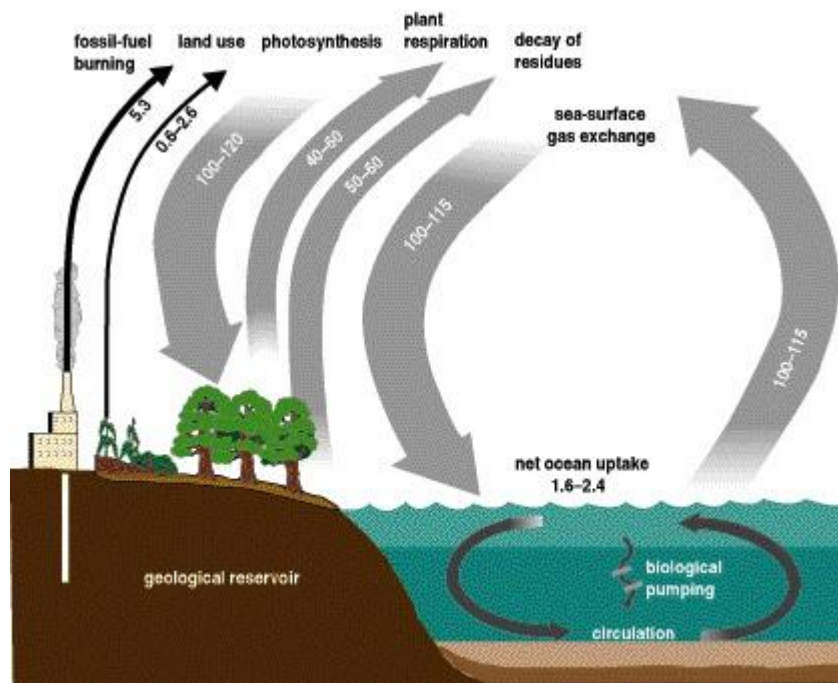


Figure 1. Burning biomass is a carbon neutral process. Oakridge National Laboratory

References

Some of this content is derived from Foster CD, Gan J, Mayfield C. 2007. Advantages of Woody Biomass Utilization. Pages 35-38. In: Hubbard, W.; L. Biles; C. Mayfield; S. Ashton (Eds.). 2007. Sustainable Forestry for Bioenergy and Bio-based Products: Trainers Curriculum Notebook. Athens, GA: Southern Forest Research Partnership, Inc. www.forestbioenergy.net/training-materials/fact-sheets/module-1-fact-sheets/

Gan J, Smith CT. 2006. Availability of logging residues and potential for electricity production and carbon displacement in the US. *Biomass and Bioenergy* 30(12):1011–1020.

Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: Mitigation Summary for Policy Makers*. www.ipc.ch Date accessed: October 24, 2005.