enviva®

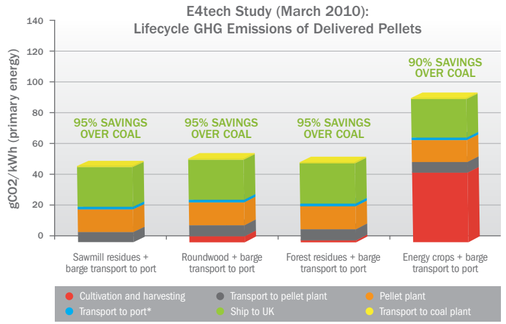
WOOD PELLET MANUFACTURING

in the Southeast United States

SOUTHEAST UNITED STATES
WOOD PELLETS' ROLE IN REDUCING GHG EMISSIONS

Multiple studies by leading research institutes confirm that firing woody biomass is the most commercially attractive and effective way to reduce GHG emissions from fossil fuel-based power plants. Studies by E4tech (UK) and other government-backed and private research bodies show that electricity produced from wood pellets harvested and manufactured in, and transported to Europe from, the Southeast United States reduces greenhouse gas emissions by at least 80% compared to electricity produced from coal.

GREENHOUSE GAS SAVINGS OF TYPICAL SOUTHEAST U.S. WOOD PELLET PATHWAY:
95% (E4tech-UK) | ***83%** (SGS Audit of Enviva for Flanders)

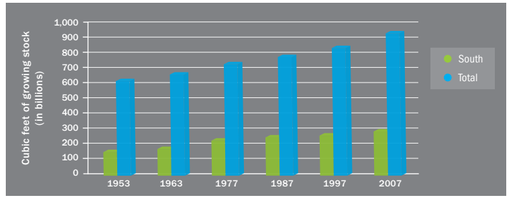


*Transport to port barge. The truck option is not shown separately as it only adds 2gCO$_2$/kWh.
NOTE: These figures do not include emissions from indirect land-use change.
*SGS calculates ~300 kWh (electric) fossil fuel consumption per tonne of pellets. Assuming 1800 kWh (electric) energy produced per tonne of pellets yields a green certificate factor of (1800-300)/1800 = 0.83.

Source: E4tech Study, March 2010

THERE ARE SEVERAL REASONS FOR THESE VERY SIGNIFICANT GHG REDUCTIONS:

Positive Drain/Growth Ratio:
The Southeast U.S. wood basket is a source of plentiful, sustainable biomass. This region consistently grows more timber than is harvested—the net volume of timber grown on forested land in the Southeast United States has roughly doubled in the past 60 years. This trend continues today. Other regions of the United States have seen similar increases lead by the Northern United States where forest inventories have swelled over 130 percent in the past 60 years.



U.S. forests are growing more timber than is being harvested every year. Since 1953, the volume of growing stocks on timberland in the south has increased from 148 billion cubic feet (4.2 billion cubic meters) to over 288 billion cubic feet (8.2 billion cubic meters). Since 1997, growing stocks in the south have increased by 32 billion cubic feet (1 billion cubic meters) or almost 13 percent.
(Source: U.S.D.A. Forest Service: U.S. Forest Resource Facts and Historical Trends 2010)

Robust Sustainable Forestry Practices:
The Southeast U.S. has developed a robust system of sustainable forestry practices, including industry leading certification programs such as the **Sustainable Forestry Initiative** (SFI), **The Forest Stewardship Council** (FSC), and **The Programme for the Endorsement of Forest Certification** (PEFC). These practices, developed over decades, ensure that forests are managed sustainably, that the local environment is maintained, and that biodiversity is protected. Biomass supply companies such as Enviva are using and building upon existing forestry sustainability initiatives such as SFI in their own operations (more details can be found in the "Adding Value Through Certification" section).

Reduced Local Transport:
In the Southeast U.S., distances between the raw materials, the manufacturing facilities, major waterways, and port export facilities are often relatively short. An extensive network of large waterways in the region makes transportation of pellets by barge feasible, in many cases, an environmentally preferable alternative to transportation by truck. (See GHG Savings Chart opposite.)

Environmentally Friendly Shipping to Europe:
Enviva's locations in the Southeast United States and their proximity to major international ports make them a more environmentally responsible partner for European utilities than an overland manufacturer. For example, 15 barges can carry the same cargo of wood pellets as 216 rail cars and 1050 tractor-trailers, making for greatly reduced emissions. (Source: 2008 National Waterways Foundation)

Furthermore, a typical ship used for dry-bulk shipments gets approximately 1750 MTKm/gallon of fuel versus 195 MTKm/gallon for trucks, which means the same amount of wood pellets can be transported nine times further via ship by sea versus a truck by land.[1]

The greenhouse gas analyses presented on the left confirm the relatively small contribution of international shipping to lifecycle "forest-to-furnace" GHG emissions of wood pellets from the Southeast U.S. By importing sustainable wood pellets from a U.S. manufacturer like Enviva, European utilities avoid the environmental impact of transporting pellets significant distances across land.

[1]For truck diesel fuel emissions: *Transportation Energy Data Book*, 28th ed., "U.S. Department of Transportation FHA Highway Statistics 2007, Table VM1." For ship diesel fuel emissions, Handymax factors: "CO2 Emission Statistics for the World Commercial Fleet," *WMU Journal of Maritime Affairs*.

Favorable Economic Environment: Wood fiber raw materials sourced from the Southeast U.S. are lower cost than wood fiber from many parts of the world, including much of the wood fiber located in Europe. As a result, many of the world's largest industrial-scale wood pellet manufactures call the Southeast U.S. home.

LIFE CYCLE OF A WOOD PELLET FROM THE SOUTHEAST U.S.

Example of a sustainable forest thinning in the Southeast U.S. Photo by David Dickens, University of GA, Bugwood.org

ENSURING THE SUSTAINABILITY OF FORESTS

Responsible management and regular removal of woody biomass maintains a forest's health in many ways. Studies have shown that biomass removal reduces the risk and severity of wildfire, while also providing carbon benefits.[1] The impact of biomass harvesting on soil quality is minimal: If harvested responsibly, there is no significant net impact on the quantity and composition of deadwood, which provides nutrients to the forest floor.[2]

Sound forestry harvest practices include minimizing soil and forest floor disturbance, leaving a safe distance from water bodies and leaving sufficient woody debris in the forest for habitat and nutrient supply.[3] These practices ensure little impact on wildlife and biodiversity.

In addition to the benefits of sustainable harvesting on forests, younger trees absorb a greater amount of carbon than old-growth trees. Therefore, methodically replanting trees or cutting trees to encourage new tree regeneration from stumps provides greater carbon benefit than leaving trees untouched.

It is imperative that companies ensure the long-term sustainability and yield of the forests from which they source their raw materials. Enviva achieves this by broadening the practice of sustainable forestry with our suppliers and wood producers to protect soil and water quality. Further details of Enviva's policies on forest sustainability certification are given in the "Adding Value Through Certification" section.

Enviva's procurement model integrates small forest owners with larger corporate land owners, with whom the procurement team maintains personal "boots-in-the-forest" relationships. This ensures that Enviva is able to closely monitor the management and health of the forests from which its raw materials are sourced.

[1]Evans, A.M., "Synthesis of Knowledge From Woody Biomass Removal Case Studies," U.S. Forest Service, September 2008, pp. 19–20.
[2]Arnosti, D. et al, *Harvesting Fuel: Cutting Costs and Reducing Forest Fire Hazards Through Biomass Harvest*, Institute for Agriculture and Trade Policy, June 2008.
[3]Evans, A.M., "Synthesis of Knowledge From Woody Biomass Removal Case Studies," U.S. Forest Service, September 2008, p. 17.
"Environmental Effects of Forest Biomass Removal," Oregon Department of Forestry, December 2008, http://www.oregon.gov/ODF/PUBS/docs/ODF_Biomass_Removal_Effects_Report.pdf

PUTTING UNDERUSED RESOURCES TO GOOD USE

Enviva produces wood pellets from both processed and unprocessed wood residues. Our processed wood raw materials include chips, bark, and sawdust by-products from wood processing facilities. Unprocessed residues include tree tops, branches, stumps, and other forestry debris remaining after the primary biomass (or the tree trunk) has been processed and shipped from the forest. These unprocessed residues would most likely otherwise go unused as a resource. Additional biomass sources currently include low-grade round timber.

The Benefits of Wood Pellets
As an energy-dense, uniform fuel made from high-quality wood materials, wood pellets offer a range of advantages. They…

- are efficient as a source of energy, reliable, and available 24 hours a day, 7 days a week.
- can be manufactured to any size specification and typically have a calorific value of about 17.5MJ/kg vs. 10.9MJ/kg for non-pelleted, non-dried wood.
- have a very low-moisture content (5–7% vs. between 40–60% for non-pelleted wood) and low ash (1–2% vs. 5% for non-pelleted wood) that enables them to ship in standard dry bulk vessels. This maximizes economic efficiency and is environmentally preferable because such vessels can be used to ship freight on the return trip as well.
- have significantly lower emissions than fossil fuels and unprocessed woody materials on an energy content basis.
- have a geometric uniform shape that makes for easy and economic transportation.
- are uniform and homogenous, making them an easily tradable commodity, which entices large players and financial institutions to enter the industry as intermediaries.

SAWDUST

WOODCHIPS

TREE LIMBS

ROUND TIMBER

ADDING VALUE THROUGH CERTIFICATION

Wood pellets offer many advantages; however, if they are not sustainably sourced or produced in a manner that minimizes greenhouse gas emissions and environmental impact, their legitimacy as a renewable fuel is undermined. Enviva is currently in the process of ensuring its operations are certified by multiple industry-leading certification bodies.

Certification schemes help hold wood pellet manufacturers to a common standard of responsible sourcing and production. Forest certification offers many benefits, including economic, environmental, and societal benefits. There are currently four major certification authorities that help ensure the responsible management of forests:

- The **Sustainable Forestry Initiative** (SFI), which was established by the American Forest and Paper Association (AF&PA) in 1994, and is "responsible for maintaining, overseeing and improving a sustainable forestry certification program that is internationally recognized..." (Source: SFIProgram.org)
- The **Forest Stewardship Council** (FSC), which was founded in 1993 to coordinate the development of forest management standards throughout the different biogeographic regions of the world, to provide public information about certification and FSC, and to work with certification organizations to promote FSC certification.
- The **Programme for the Endorsement of Forest Certification** (PEFC), the world's largest forest certification system. PEFC was formed to transform the way forests are managed globally—and locally—to help shepherd the lasting environmental, social, and economic benefits that forests offer.
- **American Tree Farm** (ATF) is recognized internationally as a credible forest certification system that works to sustain forests, watershed, and healthy wildlife habitats through the power of private stewardship by offering affordable forest certification for family forest landowners in the United States.

Despite an uncertain economic climate within the forest industry sector, forest certification programs have expanded. However, certified wood has yet to achieve critical mass in the marketplace at large. While certification programs have shown promise within the solid wood products marketplace, they still need to be more broadly accepted to extend their advantages. The harmonization of Chain of Custody requirements for multiple certification systems could go a long way toward helping the overall market grow.

Enviva endeavors to meet or exceed widely accepted sustainability standards in the forest industry, and is currently pursuing multiple certifications from these well-respected, independent certification schemes. Enviva received SFI Fiber Sourcing certification in Quarter 1, 2011 and will pursue SFI, FSC, and PEFC Chain of Custody certifications over the course of the remainder of 2011.

Additive free, 100% wood pellets.

Enviva transferring wood pellets from plant to barge to ship for trans-Atlantic shipment to European Utility.

7200 Wisconsin Ave, Suite 1100
Bethesda, MD 20814 USA

+1 (301) 657 5560
+1 (301) 657 5567 (fax)

www.envivabiomass.com

For more information on Enviva's sustainability initiatives, please email: sustainability@envivabiomass.com

SUSTAINABLE BIOMASS RESOURCES

Cover photo: Additive free, 100% wood pellets.