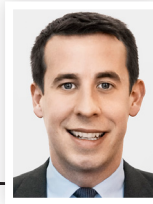


Ben Moxham

## U.S. Wood Pellets – a sustainable Alternative to Coal

erschienen 08/2016 in der Broschüre „Bioenergie und Umweltschutz“ des ÖBMV



As Austria has recognized for several decades, wood biomass energy provides a compelling answer to the energy „trilemma“ of cost, decarbonization and grid stability. It is currently the only renewable technology able to generate dispatchable electric power and heat, a system service of increasing value as a growing amount of intermittent wind and solar energy is deployed across the European Union.

Biomass energy derived from sustainably managed forests provides significant and measurable lifetime greenhouse gas (GHG) reduction benefits. The U.S. wood biomass industry has much to learn from Europe, which has a long history of wood bioenergy

use. In 2014, wood sources made up close to half of the E.U.'s total renewable energy generation.

### Bioenergy in Austria and in the U.S.

Bioenergy plays an even larger role in Austria, where there is widespread understanding of the climate benefits and lifetime greenhouse gas emissions reductions provided by sustainably managed forests [1]. In Austria, wood bioenergy primarily takes the form of residential or community-scale heat generated from forest, sawmill and wood industry residues [2]. The U.S. wood pellet production industry is developing along a

different path in several respects. First, U.S. wood pellet manufacturing facilities are generally bigger. Enviva is the largest producer of wood pellets in the U.S. and the world. Our biggest plants have a capacity of more than 500,000 metric tons of wood pellets each year. Second, U.S. wood pellet producers use a diverse range of feedstock inputs. These include low-grade wood fiber, tops and limbs, and commercial forest thinnings, as well as mill residues. Finally, most wood pellets produced in the U.S. are not consumed domestically but are exported to industrial-scale utilities in Europe, which use them to replace coal or oil products in electricity and heat generation.

### Forest owners benefit from pellets production

American forests are an ideal source of renewable energy feedstocks because of their demonstrated capacity to continually sequester carbon while at the same time supporting demand for forest products. Wood

Tab. 1: Supply chain GHG emissions for wood pellets shipped from Enviva's Chesapeake port to the U.K.

Crop Production	0	Kg CO <sub>2</sub> /ton
Harvesting and Chipping	7	Kg CO <sub>2</sub> /ton
Transport of Feedstock	8	Kg CO <sub>2</sub> /ton
Production	123	Kg CO <sub>2</sub> /ton
Transport to Port	7	Kg CO <sub>2</sub> /ton
Storage and Handling	2	Kg CO <sub>2</sub> /ton
Transport by Sea	73	Kg CO <sub>2</sub> /ton
Transport to Power Plant	6	Kg CO <sub>2</sub> /ton
<b>Total Emissions</b>	<b>226</b>	<b>Kg CO<sub>2</sub>/ton</b>
Pellet NCV*	17	GJ/ton
<b>Total Emissions</b>	<b>48</b>	<b>Kgs CO<sub>2</sub>/MWhp</b>
<b>Power Plant Efficiency</b>	<b>38</b>	<b>%</b>
<b>Total Emissions</b>	<b>126</b>	<b>Kgs CO<sub>2</sub>/MWhp</b>
<b>UK GHG Savings</b>	<b>82</b>	<b>%</b>

\* Net calorific value  
Source: Enviva data and U.K. DECC Ofgem's calculation methodology

bioenergy markets provide a supplementary income stream to private forest landowners by creating demand for low-quality harvest residues that cannot be sold into higher

Share of wood as energy source in gross inland energy consumption in the E.U. 28

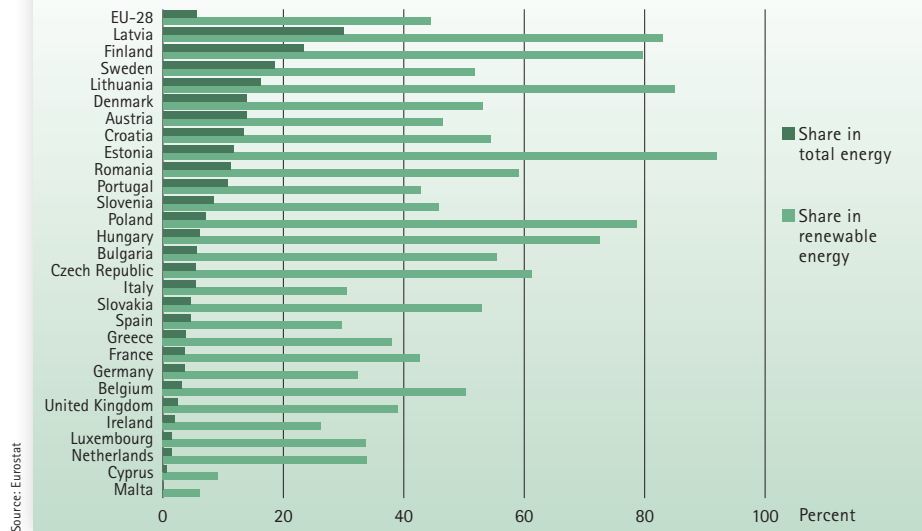


Fig. 1: Share of wood energy sources as a percentage of renewable and total energy consumption in Europe in 2014



© Austrian Biomass Association

Wood biomass accounts for about 44 % of all renewable energy in the EU, being by far the largest single source.

value markets. In many cases, these residuals otherwise would be left at the harvest site to decay and impede forest regeneration.

This added economic benefit provides landowners with an important incentive to keep their forests as forests rather than converting them to other uses, thereby producing significant carbon benefits. A May 2015 study by researchers at Duke University's Nicholas Institute for Environmental Policy Solutions and North Carolina State University examined how forests in the American South are affected by the E.U. wood pellet export market. Researchers examined whether these forests can meet E.U. sustainability guidelines and concluded that: „We show a substantial increase in the area of all forest types in the presence of increased pellet demand.“ [3]

Another study published in November 2015 came to similar conclusions. The study found that wood pellets produced in the U.S. and exported to the United Kingdom have cradle-to-grave lifecycle emissions

of 157 to 279 kilogram CO<sub>2</sub> per megawatt hour (kg CO<sub>2</sub>/MWh), which is 74 to 85 % less than coal [4]. The authors of this study included the chair of the U.S. Environmental Protection Agency's Science Advisory Board Biogenic Carbon Emissions Panel, Dr. Madhu Khanna of the University of Illinois, and another member of the panel, Dr. Robert Abt of North Carolina State University.

### Low CHG emissions along the supply chain

Supply chain greenhouse gas emissions from feedstock cultivation, processing and transport differ based on the type of biomass used and where it was produced, but are always small in comparison to emissions from coal. They comfortably meet current and future emissions reductions required by the E.U.'s Renewable Energy Directive. Tab. 1 provides estimated supply chain emissions for wood pellets using Enviva mid-Atlantic supply chain data and the U.K. Department of Energy and Climate Change's Office of

Gas and Electricity Markets accounting methodology. Biomass delivers an affordable, storable and dispatchable source of renewable energy that plays a major role in Europe's efforts to reduce carbon emissions and address climate change.

Wood biomass can be used to generate electricity more economically than a number of other forms of renewable energy. Recent studies have found that the cost advantages of wood biomass are greater than previously thought.

### Biomass most affordable renewable electricity

In December 2013, a Levelized Cost of Electricity (LCOE) analysis performed by the U.K. Department of Energy and Climate Change found that biomass conversion projects cost approximately 108 €/MWh (128 €/MWh), making this technology the most affordable renewable technology after onshore wind generation projects at 101 €/MWh (120 €/MWh) [5].

However, LCOE does not give a complete picture of the true cost of renewable energy technologies because it does not take into account the system costs of wind and solar energy. These include the need for enhanced transmission and distribution, the need for backup generation to cover fluctuations in intermittent wind and solar generation, and the additional costs posed by these technologies in electricity balancing markets.

UK-based Aurora Energy Research recently analyzed these additional system costs to come up with a more complete measure than LCOE, which they have labeled Total Cost of Energy (TCOE). Aurora found that TCOE for onshore wind is actually 115 €/MWh (137 €/MWh) with biomass conversion at 107 €/MWh (127 €/MWh), making it the most cost-effective renewable technology [6]. Fig. 2 presents the detailed results from Aurora's research.

### Healthy and extensive forests in the U.S. South

Forests in the U.S. are abundant, healthy and growing, and wood pellet production accounts for only a small part of U.S. forest product demand. The forests of the U.S. South are extensive and dynamic, and have been managed for timber and agriculture since European settlement in the 18<sup>th</sup> Century. The trees harvested today form the fifth or sixth generation of Southern forests, and current forest conditions reflect the legacy of a long history of land use, strong private property rights and a robust forestry industry [7].

The South has experienced little net change in forest area since the 1940s, and Southern forests today cover 99 million hectares – about 45 % of total land area in the South [8] and over 12 times the total land area of Austria [9].

Since the rise of forest product markets in the 1950s, both timber production and forest growing stocks in the U.S. have more than doubled. About 86 % of Southern forests are privately owned. The biggest threat to forests today is land use conversion driven by urbanization and agricultural demand; strong forest product markets are a critical incentive for retaining forestlands and the ecosystem services they provide.

### Only 2.4 percent of forest harvest used for pellets

Fiber demand for bioenergy makes up a small portion of total Southern forest product demand and does not dictate forest management practices. In 2014, wood pellets accounted for only 2.4 % of the total volume and 3.8 % of pulpwood volume harvested from forests. Fig. 3 and Fig. 4 show the relative demand from different forest product industries for hardwood and pine wood from 2000 to 2014. During this same time period, total forest inventory increased by 19 % [10].

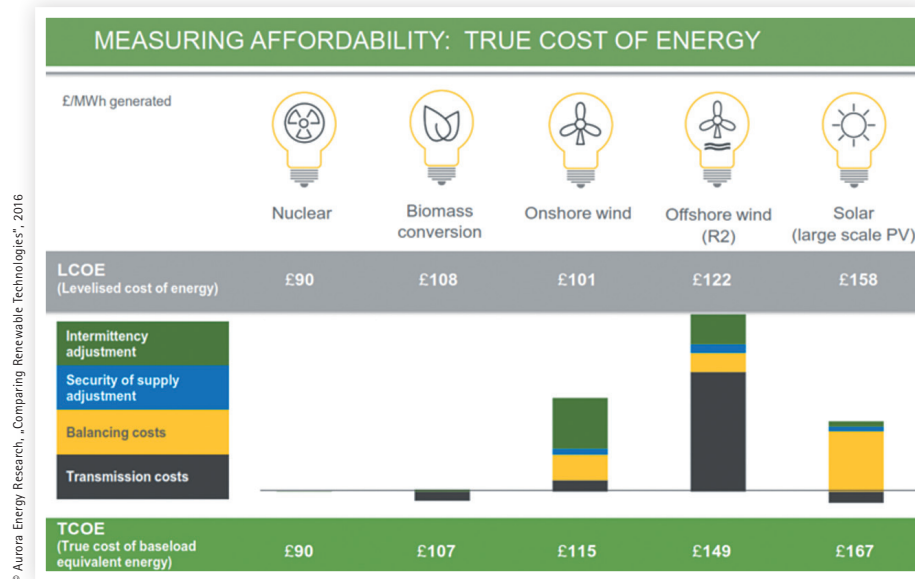


Fig. 2: Net system value of different renewable and low carbon energy technologies



Pellet manufacturers source wood fiber from working forests, sawmills and other wood industry manufacturers. Many production facilities have been located in the Southeast because of its abundance of working forests and growing timber inventories. Wood pellet raw materials consist of:

- **Low-grade wood fiber:** Wood that is unsuitable for, or rejected by, the sawmilling and lumber industries because of small size, defects (crooked, knotty etc.), disease or damage from pest infestation
- **Tops and limbs:** The parts of sawtimber trees that cannot be processed into lumber
- **Commercial thinnings:** Fiber from harvests that promote the growth of higher value timber by removing weak or deformed trees to reduce competition for water, nutrients and sunlight
- **Mill residues:** Chips, sawdust and other wood industry residues.

Moreover, by offsetting the effects of a diminishing U.S. pulp and paper industry, pellet mills provide incentive for the effi-

cient use of forest resources, improvements to forest health and resiliency and critical support to rural economies. The pulp and paper sector is undergoing long term structural changes due to the rise of electronic media and a decline in paper demand that has deviated from growth trends in the overall U.S. economy. The U.S. South, which supplies 18 % of the world's pulpwood, has been particularly affected, with over 500 mill closures since 2005 [11].

### Monitoring and certification programs

Sustainability regulations are imperative for maintaining the long-term viability of working forests and ensuring the benefits of bioenergy. Existing forest monitoring and certification sustainability assurances effectively preserve important ecosystem services and functions.

Globally recognized certification programs include criteria to ensure that forestry practices maintain biodiversity and ecosystem services. For example, as part of the certification process for the Sustainable Biomass Partnership feedstock complian-



© Enviva (3), proPellets Austria

Common wood pellet feedstocks for the pellet production in the U.S. South

ce standard, members must include „control systems and procedures to verify that negative impacts on groundwater, surface water and water downstream from forest management are minimized“. [12]

In the U.S., demonstrating compliance with this indicator relies on a system of applicable laws and regulations as well as individual sourcing policies of the certified entity. For this particular indicator, biomass producers can provide evidence that the federal-level Clean Water Act (CWA) requires that surface and groundwater sources are preserved; state-level rules on

Best Management Practices dictate how the CWA's requirements should be applied; and state forestry agencies monitor forest management activities to ensure these rules are being implemented. A number of federal agencies monitor the growth and sustainability of forests. These include the U.S. Department of Agriculture Forest Service [13] and the U.S. Department of the Interior. They have standards that protect wildlife habitat and water quality and ensure forest regrowth. One of the „strategic goals“ of the Forest Service [14] is to support wood biomass markets as a strategy

### Hardwood fiber demand of different forest product industries in the U.S. South

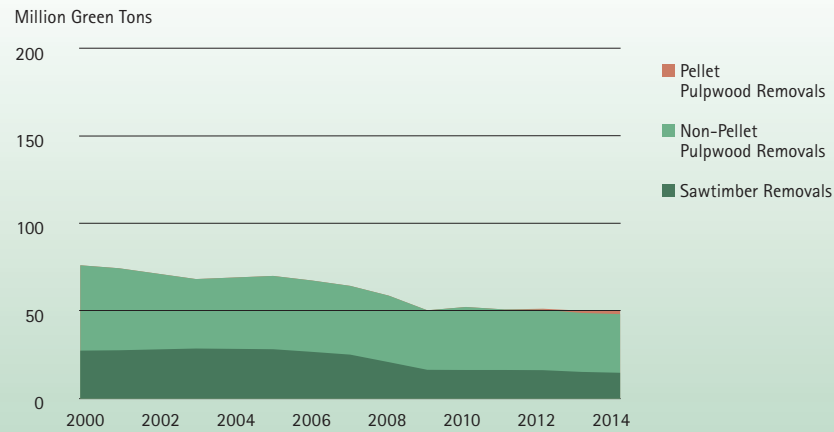


Fig. 3: The Pellet industry accounted for 4.5 % of total hardwood removals in 2014.

### Softwood fiber demand of different forest product industries in the U.S. South

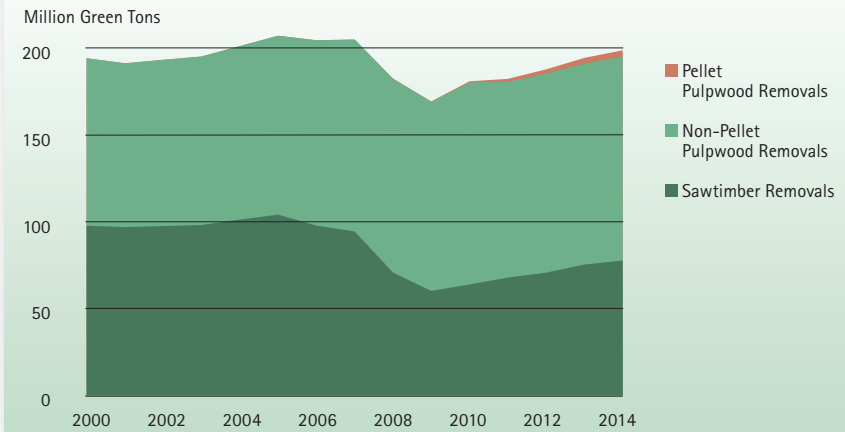


Fig. 4: The Pellet industry accounted for 1.9 % of total softwood removals from forests in 2014.

for managing federally owned forestlands. State governments create and enforce their own state-level Best Management Practices (BMPs) for forest harvesting that ensure the protection of soil and water quality and threatened and endangered species.

### Enviva's own initiatives for forest sustainability

Enviva goes beyond these controls and has developed several of its own initiatives to promote forest sustainability. We have a proprietary „track and trace“ program that compiles detailed information on the source and characteristics of every truckload of wood we use. We also conduct ongoing audits to ensure that our timber suppliers protect water quality, limit other ecological impacts and operate according to Best Management Practices.

Moreover, Enviva has made a significant financial commitment to the future of forestry through The Enviva Forest Conservation Fund. This 5 million U.S. Dollar, 10-year-program is designed to protect and conserve tens of thousands of hectares of sensitive bottomland forests in northeast North Carolina and southeast Virginia. The Enviva Forest Conservation Fund is administered by the U.S. Endowment for Forestry and Communities and awards grants to organizations whose mission is to protect ecologically sensitive areas and conserve working forests.

The goal of most private landowners is to manage their forest for a sustainable supply of timber that provides a financial return. This includes maintaining the productivity and ecosystem function of their forestland. Without demand for timber, landowners would have little incentive to keep their land in forest, as other land uses would become more attractive. Strong forest products markets incentivize forestry as a land use, which in turn supports biodiversity and the ecosystem services provided by forests. ■

### Literature

- [1] Austrian Biomass Association. (2016, May 17). Climate Change. Retrieved from Austrian Biomass Association: <http://www.biomasneverband.at/en/bioenergie/klimaerwaermung/>.
- [2] Austrian Biomass Association. (2016, May 17). Climate Change. Retrieved from Austrian Biomass Association: <http://www.biomasneverband.at/en/bioenergie/energie-aus-biomasse/waerme/>.
- [3] Christopher S. Galik & Robert C. Abt, Sustainability Guidelines and Forest Market Response: An Assessment of European Union Pellet Demand in the Southeastern United States 7, *Global Change Biology Bioenergy*, doi:10.1111/gcbb.12273, 2015.
- [4] Wang, Weiwei, Dwivedi, Puneet, Abt, Robert, and Khanna, Madhu. (2015). Carbon savings with transatlantic trade in pellets: accounting for market-driven effects. *Environmental Research Letters*, November 2015.
- [5] UK Department of Energy and Climate Change. (2013). *Electricity Generation Costs 2013*. London: UK Department of Energy and Climate Change. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223940/DECC\\_Electricity\\_Generation\\_Costs\\_for\\_publication\\_-\\_24\\_07\\_13.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf).
- [6] Aurora Energy Research. (2016). Comparing costs of renewable technologies. Aurora Energy Research Limited.
- [7] Wear, D. N., & Greis, J. G. (2002). Southern Forest Resource Assessment: Summary of Findings. *Journal of Forestry*, 6-14.
- [8] Oswald, Sonja N.; Smith, W. Brad; Miles, Patrick D.; Pugh, Scott A. 2014. *Forest Resources of the United States, 2012: a technical document supporting the Forest Service 2015 update of the RPA Assessment*. Gen. Tech. Rep. WO-91. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office.
- [9] Food and Agriculture Organization of the United Nations, *Global Forest Resources Assessment 2015*.
- [10] Food and Agriculture Organization of the United Nations, *Global Forest Resources Assessment 2015*. <http://www.fao.org/forest-resources-assessment/en/>
- [11] Woodall, C. W., Ince, P. J., Skog, K. E., Aguilar, F. X., Keegan, C. E., Sorenson, C. B., . . . Smith, W. B. (2012). An Overview of the Forest Products Sector Downturn in the United States. *Journal of Forest Products*, 595-603.
- [12] Forest2Market, Inc. (2015). *Wood Supply Trends in the US South 1995-2015*. Charlotte: Forest2Market, Inc.
- [13] U.S. Forest Service, webpage, May 6, 2016, <http://www.fs.fed.us/forestmanagement/aboutus/lawsandregs.shtml>.
- [14] U.S. Forest Service, webpage, May 6, 2016, <http://www.fs.fed.us/woodybiomass/strategy/index.shtml>.

---

Ben Moxham  
*Director Europe, Enviva,*  
*Ben.Moxham@envivabiomass.com*

