Biomass and Rural Economies

BTEC
Biomass Thermal Energy Council

Provides an overview of the positive economic impact of biomass thermal energy on rural communities. Highlights the many components of the economic value chain- landowners, foresters, loggers, pellet manufactures, etc – and their impact on local economies.

Introduction

Biomass thermal energy is the combustion of organic materials, originating at or above the earth's surface, for the purpose of generating heat. This heat can be applied to maintain warmth in a building. It can also be used to heat multiple buildings, or even a whole town, in a process known as district heating. Biomass can be combusted to create electricity, such as a biomass combined heat and power (CHP) plant. Biomass is renewable, as it is derived from plant material, which will grow back. Like all renewable energies and materials, it is only renewable if harvested sustainably, which is to say that the harvest rates should not exceed the rate of regrowth.

Biomass thermal is also a carbon-neutral energy source, when used in a sustainable manner. There is a finite amount of carbon in the global system that exists in non-permanent storage. While some carbon is permanently fixed in the slow formation of rocks and minerals, and some carbon is added through volcanic activity, the primary input of carbon into the system is the extraction and combustion of fossil fuels that originate beneath the earth's surface. When biomass is combusted, it does release carbon into the atmosphere, however, when harvested sustainably, the amount of plant growth will equal the amount of biomass combusted, creating a net-zero gain in atmospheric carbon. Biomass does not comprise a new input into the carbon cycle.

Economic Overview

Biomass has increased as a percentage of total energy used domestically 20% between 2000 and 2007, representing growth from 3% to 3.6% of total domestic energy use in the same period.[1] As costs of many fossil fuels rise, the demand for affordable energy will continue to grow. Biomass, when compared to oil, is already economically favorable in terms of fuel price per British Thermal Unit (BTU) of energy, a trend that is likely to increase. Furthermore, biomass is produced domestically, so it can help to maintain and create jobs in the United States, as well as prevent money from leaving the local economy in the form of purchases of imported energy.

The biomass industry is projected to have rapid growth in the next decade. Between 2010-2020, the biomass industry (including solid biomass as well as biofuels) is expected to grow by 7.4% yearly in terms of BTU's of energy and heat produced. Of this growth, 84.3% is expected from solid fuel biomass, such as wood and agricultural pellets and chips[2].

As the demand for woody biomass increases in response to a growing biomass energy, the value of forested property suited for biomass production is also likely to increase.[3] An increase in property value of forested landscapes will benefit rural communities in a variety of ways, including an increased tax base for local schools, more business options for forest owners, and an incentive to keep land forested.

Furthermore, the growth of a biomass energy will create local jobs in a variety of sectors along the entire supply chain of biomass fuel. Feedstock for biomass facilities, must be produced locally, thereby ensuring local job creation. A rule-of-thumb for maintaining economic and ecological benefits is that the feedstock should originate within a 50-mile radius of the end-use or of a pellet manufacturing plant.[4] This radius may be expanded in certain situations, such as where the costs of fossil fuel alternatives are higher, or in situations when transportation companies have developed cheaper transportation methods, such as more fuel efficient delivery trucks or the use of rail. However, most of the supply chain occurs locally, keeping money spent on biomass energy in the community.

Market Overview

Greater demand for timber has been shown to increase the area of forested landscape in domestic forests.[5] Demand for timber and biomass has been identified as a driver of deforestation in Haiti[6], and in some parts of sub-saharan Africa. This trend has not occurred in the United States, where forestry is practiced in a manner that is closer to sustainable principles than in the aforementioned regions.

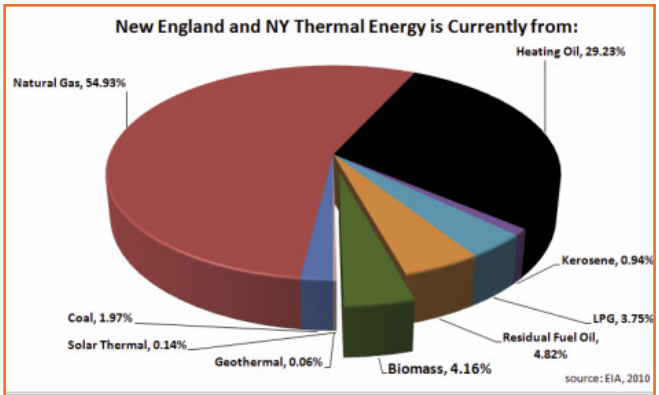
It may be intuitive to think that an increased demand for wood materials will lead to increased harvesting of trees, and thus a decreased supply of trees. In fact, the opposite occurs in most developed nations. Timberland investors should not be defined exclusively as producers of wood-products, but instead as land owners who choose to employ their property for profit through the harvesting of timber. The land-use decisions of a landowner are driven by market conditions for what their land can produce. In the United States, the risk of deforestation is not driven by demand for wood products, but instead is driven by land-use change pressures. If it is more profitable to convert forested land into agricultural land or into residential development, many forest owners will do so. If it is more profitable to use land as forests, more landowners will take this route. Therefore, the development of markets for wood-products will increase the forested area, not lead to deforestation.[7]

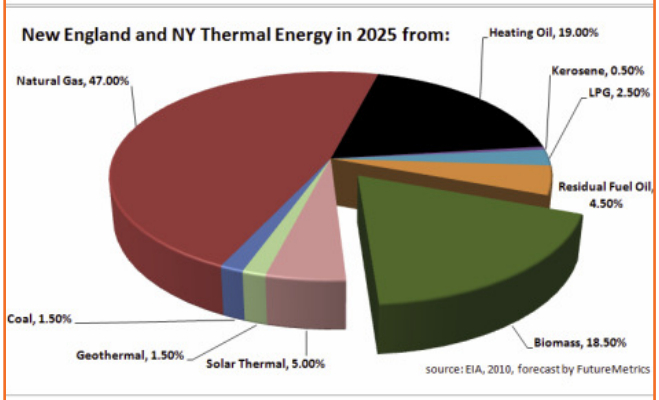
A result of new markets for forest residuals, forested property land values have skyrocketed in Britain. Britain has a much larger share of its energy coming from biomass sources than the United States. Among other factors, the increased demand for biomass in Britain has led to a 138% increase in the value of forested land consisting of 25 hectacres or more of contiguous property between 2002 and 2009.[8] While real estate is never driven by a single factor, it is likely that an increased commercial potential for forested land will increase the value of forested land in the United States as well.

The *Heating the Northeast with Renewable Biomass* report includes several key projections about the economic benefits of biomass thermal. The report suggests a change in the energy sourcing for the region consisting of the New England plus New York. The proposed change would increase the portion of energy from renewable sources from 4.3% to 25% by 2025. As part of this, 18.5% of total energy sourcing would come from biomass.

If these changes are made, the report projects that the region would displace over 1.14 billion gallons of oil annually and gain 140,200 permanent jobs, mostly middle class positions in rural regions. It would also inject $4.5 billion dollars per year into the local economy,

[1] Kimball et al. 2010. How Do Taxes Affect America's Private Forestland Owners? Journal of Forestry. 108(2): 93-97
[2] Global Data. 2011. Biopower - Global Market Size, Feedstock Analysis, Regulations and Investment Analysis to 2020. Executive Summary.
[3] Strauss, W. 2009. Futuremetrics/BTEC. An Analysis of the Expected Demand for Wood Pellets Fueled Residential Boilers.
[4] Tefteller, E. et al. 2011. Biomass Sourcing Project Final Report, Jon Finley. University of Iowa - Office of Utilities & Energy Management, Office of Sustainability.
[5] Wear, D.; Greis, J. Southern Forest Futures Project. USDA.
[6] Razafindrazay L. at al. 2011. Haiti: A Spatial Analysis of Deforestation, Earth Institute, Columbia University.
[7] Wear, D.; Greis, J. Southern Forest Futures Project. USDA.
[8] The Biofore Company. 2010.UPM Tilhill and Savills Forest Market Report 2010.





Current and 2025 Forecast of Thermal Energy Consumption in New England and New York. Source: Futuremetrics/BTEC

and retain an additional $1.6 billion dollars in annual income as the majority of the money would stay in the region and not sent abroad. It would greatly reduce mercury and sulfur emissions that cause acid rain damage to forests, and decrease greenhouse gas emissions that contribute to climate change.[9]

Job Creation

The biomass industry significantly benefits the national economy, and particularly benefits local economies. The United States has an abundance of forested land, totaling 747 million acres[10]. Sustainable management has kept domestic forest size growing or stable in the lower 48 states. The forestry and logging industries directly employ 98,800 jobs. Support industries to the forestry, such as logging, add up to another 141,300 jobs[11].

Biomass is an additional market for forest products, ensuring the forest resource industry can continue to grow and continue to provide Americans with skilled and well-paid jobs.

In the region of the New England and New York State, it has been estimated that for every 100,000 tons of pellets manufactured, 342 direct jobs are generated. These jobs include logging, chipping and trucking.

The economic multiplier for biomass energy varies regionally, based on fuel source, scope of the energy project, population density and other factors. However, one study found an economic multiplier of 3.2 for the entire supply chain. That means that for every job created directly in the industry, another 2.2 jobs are created in other industries as a result. Examples of indirect jobs include a deli near a logging site that hires an additional cook as a result of increased business. Another effect may be the hiring of new teachers at a public school supported by tax dollars from a local biomass district energy plant.[12]

The Stakeholders

Landowners

Landowners own the capital. They own the forests. Management decisions, such as if to harvest, are ultimately up to them.

Foresters

Foresters are skilled professionals who make decisions or recommendations about forest management based on the goals of the landowner.

Loggers

If a forest is being thinned or harvested, loggers are the individuals who physical perform these actions. They are instructed by the forester.

Transportation

After timber is felled, it must be transported out of the timber site and to a destination for processing. Most operations use trucks to transport their product out of the harvest site. Some timber companies will use helicopters or boats, but these methods are more appropriate for large logs, not the smaller products associated with biomass.

Mills and Pellet Manufacturers

Historically there have been two primary industrial uses for timber: wood products and paper. Biomass allows for a third use, energy. While paper mills use virtually all the wood cut, wood product mills use only a portion of the total wood felled. Curved areas, portions with cavities, branches and very small trees are not used for the making of saw logs. The resultant waste can be compressed into pellets or chipped. The pellets and chips can be sold to biomass facility to produce heat energy. This creates a market for timber mill waste, a win-win scenario for environmentalists and business owners.

Boilers/CHP Construction and Operators

From 40 megawatt combined heat and power (CHP) plants to residential biomass boiler systems, there are skilled individuals who manufacture, maintain and operate this machinery. A full CHP power plant may employ dozens of individuals, including engineers, human resource professionals, secretaries, laborers, and maintenance workers. Smaller biomass projects have a smaller economic impact per unit sold, although the potential to sell more units of this manufactured product and may effect the economy in the consideration of scale.

End Users

The end users are the ultimate drivers of demand for the industry. They receive a final product, be it pellets, cords, or chips, and consume this product for their heating needs.

Case Study: Fuel for Schools Program

How has this technology been applied in the real world? Consider Darby, Montana, and the conversion of their public school's oil heating system to biomass. Darby is a small community located in rural western Montana, surrounded on three sides by the Bitterroot National Forest. Like most communities, the funding for the public school system is based on local taxes. To reduce costs, the Darby Central District partnered with the National Park Service to create a biomass thermal boiler that would provide heat for their school buildings. As a result, they were able to replace their oil-fired steam heating plant, with a biomass thermal system that operates on wood chips purchased from the US Forest Service. While not all communities will be located next to a National Forest that can provide a steady supply of low-cost chips resulting from thinning, most cities and almost all rural communities have access to affordable chips or pellets through commercial distribution or as a result of residues from forest or agricultural management.

The Darby School District was able to heat 82,001 square feet total over three schools; the elementary school, the junior high school, and the high school. While reliably and effectively heating this space, the school district replaced 47,600 gallons of oil with 633

[9] Strauss, W. 2009. Futuremetrics/BTEC. An Analysis of the Expected Demand for Wood Pellets Fueled Residential Boilers.
[10] Forest Resources in the United States. 2011. The National Atlas. http://www.nationalatlas.gov/articles/biology/a_forest.html
[11] Bureau of Labor Statistics. Career Guide to Industries, 2010-11 Edition. http://www.bls.gov/oco/cg/cgs001.htm
[12] Strauss, W. 2009. Futuremetrics/BTEC. An Analysis of the Expected Demand for Wood Pellets Fueled Residential Boilers.

Darby Schools Fuel and Cost Savings for Heating System						
	Oil Use (gal)	Oil Cost	Wood Use (Ton)	Wood Cost	Liquid Petroleum	Total Cost
2003-2004 Estimate - Heating System with Oil	47,600	$51,844	0	$0	$2,080	$53,924
2003-2004 Actual Cost with Wood Boiler	10,165	$11,080	633	$18,357	$0	$29,437
Savings						**$24,487**
2004-2005 Estimate - Heating System with Oil	47,600	$88,060	0	$0	$2,500	$90,560
2004-2005 Actual Cost with Wood Boiler	1,900	$2,451	755	$26,660	$0	$29,111
Savings						**$61,449**
Total Savings over 2 Years						**$85,936**

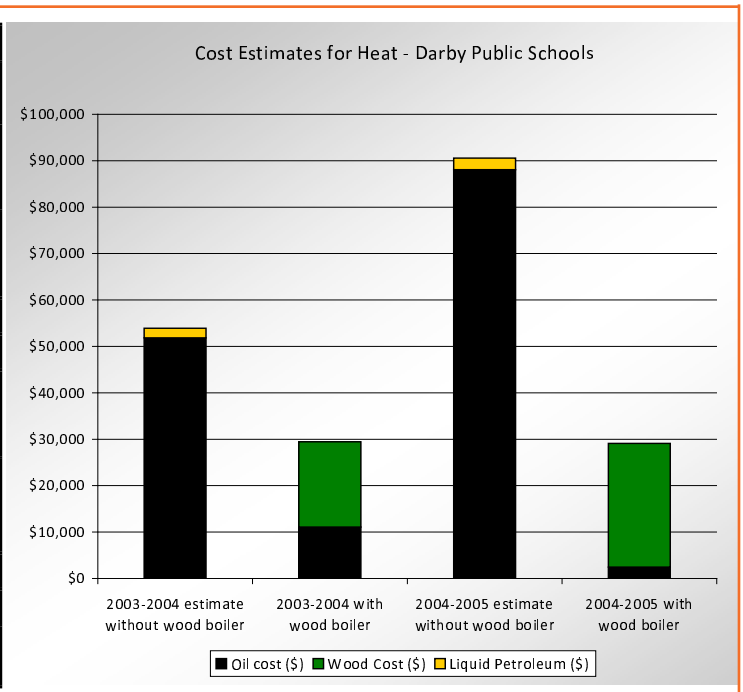


Chart and Graph created with Data from Bergman et al.

tons of wood and 10,165 gallons of oil. This resulted in a yearly saving of $24,527 in the '03 to '04 school year. The next year, when the price of oil spiked, their realized savings was even greater, with a total of $61,509[13].

Changes in Forest Management

Forest thinning in timberland managed for commercial harvest is a well-established practice that is akin to weeding a garden. Smaller and less merchantable trees are often removed to prevent them from using resources (water, soil nutrition, space etc.) that larger and more merchantable trees need to grow quickly. Just as plants in a garden that are not desired are taken out by a gardener to allow the planted species to thrive, a forester often removes non-merchantable timber to encourage growth of their desired trees. Typically, thinned woody material is left on the forest floor. The biomass industry creates a market for this material. Thinned material can then be taken out of the forest, chipped or compressed into pellets, and sold as a fuel.

Public land and private land is also thinned to prevent forest fires. To this end, the woody slash must be removed from the forest to prevent accumulating dry fuel loads on the forest floor. Again, this material can be sold as fuel. Thus, increased incentive to thin forests may result in reduced risk and severity of forest fires[14] and better yields for hardwood forests managed for timber.

A typical problem in land management in the United States is that timberland taxation is based on the ad valorem principle, meaning that the tax is based on the actual value of the land and the components of the land thereof, such as the value of standing timber. Since the tax rate for timberland is based in part on the value of the timber standing on the land, this can create a "time-lag" effect, where yearly taxes are imposed, but revenues are not generated yearly[15]. Although many states and local communities have exemption plans that timberland owners can apply for, the basis of land taxation lies in the ad valorem principle. This creates an incentive for landowners to harvest their timber before it is fully mature, since mature forest stands will be taxed at a higher rate than immature stands. This is contradictory to the often cited policy goal of fostering mature or "old-growth" forests. The creation of a market for residual woody products from a forested location, including wood derived downed woody debris, thinning residuals, and sustainable selection cutting, can generate yearly additional income to offset the tax burden for a landowner seeking to maintain a mature forest stand. While any biomass sold would be taxed as income, it would not significantly raise the land tax rate, particularly in hardwood stands, as this is primarily a function of the standing timber on site.

Agricultural Communities

The potential for additional revenue for farmers through biomass is a tremendous boon for agricultural communities. Like corn ethanol (the most commonly produced ethanol in the United States), biomass uses agricultural products to generate a compustable fuel product. However, biomass differs from ethanol in several key ways. Biomass involves the harnessing of energy from solid materials and is not a biofuel like corn ethanol. Secondly, biomass thermal power is designed with a local manufacturing and distribution network, which is different than a centralized national-scale distribution network. Thirdly, biomass thermal energy is designed as a source of heat and power for buildings, not as a transportation fuel. Fourthly, corn ethanol production is mutually exclusive from food production, which is to say that corn used for ethanol is not also used for food, while residual plant waste used for biomass can be harvested in addition to a successful food harvest. Finally, the energy ratio of domestic corn ethanol has mixed data in the literature, ranging from a low 1.17:1 ratio[16] to negative[17]. The energy ratio of biomass varies based on the source of the biomass, the distance shipped during the supply chain and the efficiency of the boiler. One study found that biomass had a 10.41:1 ratio, when considering the harvest of naturally growing small diameter ponderosa pines in Arizona

[13] Bergman, R; Maker,T.M. 2007. Fuels for Schools: Case Study in Darby, Montana. USDA Forest Service. General Technical Report FPL–GTR–173.
[14] Demchik, M.C.; et al. 2009. Combining Biomass Harvest and Forest Fuel Reduction in the Superior National Forest, Minnesota. Journal of Forestry, p 245-242.
[15] Kimball et al. 2010. How Do Taxes Affect America's Private Forestland Owners? Journal of Forestry. 108(2): 93-97
[16] Elbheri, A. 2008. The Economics of Biomass Feedstocks in the United States: A Review of the Literature. Occasional Paper No. 1. Biomass Research and Development
[17] Pimental, D. Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts Are Negative Natural Resources Research, Vol. 12, No. 2, 127-134.
[18] Pan, F. et al.;. 2008. Net energy output from harvesting small-diameter trees using a mechanized system. Forest Products Journal. Vol. 58 No.1/2

with forty miles of total transportation along the supply chain[18].

Farms produce waste. Very few farm products encompass the entire product, instead an element of the plant is harvested, leaving the rest as a waste material. There are already some uses for these waste materials, such as natural fertilizers and mulch. However, the biomass industry develops a tangible market for this material. Animal manure, corn stover and agricultural tree prunnings will have a viable market in the future, assuming the biomass industry continues its current rate of growth.

Corn stover should be of particular interest to individuals in the agricultural community. Corn is the second most commonly grown agricultural product in the United States, after soybeans[19]. Corn stover, or the non-edible parts of the corn plant, is currently used in the making of ethanol. A leading pellet manufacturer has recently developed and patented a process to make biomass fuel pellets from corn stover[20]. The benefit to farmers seeking to profit in the emerging biofuels industry is that they do not need to make any significant changes in the composition of the products they are producing; they are able to continue to produce corn, and have an additional market to sell that product.
The growth of the biomass industry will have positive effects for the nation's farmers. One major study concluded that "net farm income would increase by a cumulative total of $181billion compared with USDA baseline projections, including $37 billion in 2025 alone."[21]

Conclusion

The growth of the biomass industry domestically should substantially help America's farmers, foresters and individuals living in rural communities in the United States. Biomass use for heating and CHP will reduce reliance on foreign oil and prevent negative environmental impacts that are associated with dominant fossil fuels. It is carbon-neutral and supports the local tax base. It may reduce the severity and tendency of forest fires, increase timber productivity, and provide affordable heat and electricity to a variety of communities. Biomass is a domestic, renewable, carbon neutral source of energy that can help America's rural communities and the economy as a whole.

WERC
Wood Education and Resource Center

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This fact sheet is available online at www.biomassthermal.org.

Fuel The Biomass Facility at the Public School - Photo From Bergman et al.

[19] Perlack, R.D. et al.; Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply. USDA/DOE Study DOE: GO-102005-2135
[20] Bevill, K. 2011. Ethanol Producer Magazine. Pellet Technology targets cellulosic ethanol producers. http://www.ethanolproducer.com/articles/7820/pellet-technology-targets-cellulosic-ethanol-producers
[21] Smith, R.J.. et al. 2007. 25x'25 Action Plan: Charting America's Energy Future. 25 by '25. Organization.