Clean Heat and Power Market Assessment for the Forestry Industry in Georgia

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This assessment contains the following sections:

Executive Summary

What is Clean Heat and Power?

Forestry Industry Fuel Sources

Forestry Industry Divisions

CHP in the Georgia Forestry Industry

Barriers to CHP Development

Exploring Implementation of CHP

Conclusions

Appendix A: Forestry Industry Profile

Appendix B: CHP Technologies

Executive Summary

In the beginning of 2008, the Southeast CHP Regional Application Center commenced work pertaining to Clean Heat and Power (CHP) and the Industries of the Future as designated by the United States Department of Energy (DOE). This report describes the Georgia forestry industry and its potential for fostering CHP development.

Clean heat and power (CHP) is an effective way to increase energy efficiency and reduce polluting emissions. CHP applications may reduce consumer costs and provide reliable heat and power to a facility. Favorable scenarios for CHP applications exist near well matched thermal and electrical loads or in industries with access to an abundant fuel source. If a facility uses substantial amounts of both heat and electricity, there is a possibility of implementing CHP.

The state of Georgia contains the largest area of forest in the south with 67% of the state being covered by forests. Of that, 98% is considered timberland or suitable for timber production by the Georgia Forestry Commission. Forestry and forest products account for 24% of all manufacturing in the state, making it the largest industry in the state.

Nationwide, the forestry industry consumes over 3 quadrillion btus of energy/yr. This number is despite the fact that CHP has been in use in the forestry industry for over seventy-five years. Chemicals are re-used and heat is recaptured to produce steam for electricity production in most mills in Georgia. Approximately 3% of the value of finished products are associated with energy usage in the forestry industry. This number is twice that of similar manufacturing industries. The fact that the forestry industry is regarded as an energy-intensive industry has prompted a market assessment of CHP in the Georgia forestry industry.

While the forestry industry already engages in many forms of CHP, these are mostly applications that produce heat, steam or provide electricity for the specific facilities themselves. This assessment attempts to evaluate the current CHP efforts in the industry as well as determine opportunities for CHP in unexplored areas that may serve to lower costs and/or increase energy efficiency for the forestry industry in the state of Georgia

What is Clean Heat and Power?

Conventional electricity production, as it exists today in the United States, is only about 33% efficient[1]. The waste of approximately two-thirds of internal energy from a fuel is generally accounted for by thermal losses resulting from the thermodynamic cycle used in standard electricity production and losses in the transmission and distribution system. Clean heat and power (CHP) systems capture and utilize these heat losses by applying thermal energy to existing needs.

CHP is an integrated energy system located at or near a facility to provide at least a portion of the electrical or mechanical load while recycling the waste heat from the power application to provide heating, process steam, cooling, and/or dehumidification or the production of electrical power[1].

Common thermal loads for CHP applications can be cooling, heating, humidity control systems, steam production, and hot water production. CHP can also utilize opportunity fuels such as LFG, biomass, and digester gas[2,3].

By capturing waste heat, CHP systems, if effectively integrated, can reach up to or greater than 80% efficiency[4]. An illustrative example of CHP system efficiency can be seen in Figure 1: CHP Efficiency. Additionally CHP includes the added benefit of power availability and reliability. CHP also alleviates grid overcrowding and costs associated with distribution[5]. If a utility outage occurs, a CHP system can maintain operation and lessen the effect of the outage on a facility[6]. Certain facilities have a requirement for constant, uninterruptable steam and power. An example of such a facility is the Bristol-Myers Squibb facility in Wallingford Connecticut. The requirement for a closely monitored working environment led Bristol-Myers to install a CHP system which provides 4.8 Megawatts (MW) of generating capacity[7].

One report estimates that power interruptions cost industries $80 billion dollars annually in the United States. The commercial and industrial sectors incur the largest costs associated with power outages. It was also shown that "momentary interruptions," those lasting less than five minutes were more expensive than "sustained interruptions[8]." CHP installations can reduce the effects of power outages in an industrial manufacturing setting such as the glass industry. When interconnected with the utility grid, during an outage, power can be obtained from the CHP system without costly interruption.

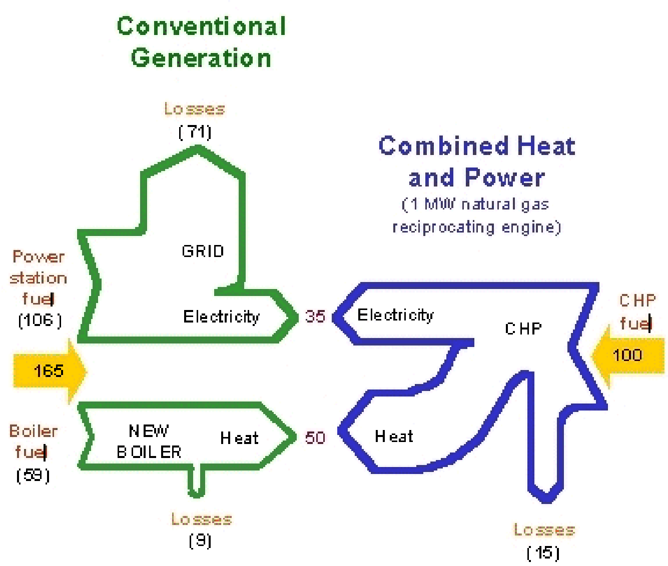


Figure 1: CHP Efficiency

A CHP system also includes the benefits of reduced emissions due to increased system efficiency. If the potential for CHP in the United States was met, approximately 130GW, the carbon equivalent emissions would shrink by 70 million metric tons[6].

Forestry Industry Fuel Sources

Black Liquor

Black liquor is a byproduct of the pulping process which is typically burned in the recovery boiler during the kraft process with the purpose of generating heat, steam and electricity for the mill. Since the black liquor is only available in limited quantities, it is rarely utilized out the local facilities for energy production. The costs of transporting collecting the excess, if any, black liquor for outside energy production would likely outweigh any economic benefits. Since pulp and paper mills currently benefit greatly from using black liquor as a fuel, there is little reason for them to factor in added costs to use it in outside applications. Therefore, there is likely not an additional market for the use of black liquor, in which case it will not be discussed in this paper. [9]

Wood (Forest Residues)

Forest residues include wood trimmings, chips, and branches as well as mill residues such as bark, sawdust and shavings. The burning of wood fuels accounts for over two-thirds of all biomass electrical generation.[10] Wood fuel consumption most often takes place is lumber processing, pulp and paper mills where residues are burned to produce heat and steam for the plant. Many mills utilize gasification systems to produce biomass gas, which will be discussed later in this paper. The Oak Ridge National Laboratory estimates that Georgia currently has more than 1,967,800 tons of forest residues that have the capacity to generate over 423 MW. This amount of forest residue is the fourth most in the United States.

Urban Wood Waste

Urban wood waste consists of yard trimmings, wood pallets, and construction and demolition waste. Urban wood waste is very different from Forest residue. Processing costs are less and the waste itself is less expensive, but is often contaminated with impurities so equipment and maintenance costs tend to be higher. According to the Oak Ridge National Laboratory, Georgia has 1,436,823 tons of available urban wood waste capable of producing 313 MW[11]. That is the sixth largest amount in the United States. Using urban wood waste as a fuel would require the development of a large-scale infrastructure for collecting and processing the fuel. While urban wood waste consists of a major source of potential biomass fuel, implementations would be in direct opposition to the infrastructure already in place for forest and mill residues in the pulp and paper industry which will be discussed in more detail.

Forestry Industry Divisions

Timber Growing and Harvesting

Timber growing and harvesting consists of the on-site logging operations of the industry. On-site logging operations include felling, de-limbing, bucking(cut into logs), and loading onto a truck for transportation. According to the Georgia Forestry Commission, approximately 1.2 billion cubic feet of timber was produced by the state in 2006. Georgia has over 23 million acres of harvestable land at its disposal as of 2004.[12] Some of the largest logging companies in Georgia include:

- Georgia-Pacific
- MacIntyre Lumber Company
- Plum Creek

Wood and Wood Fiber Processing

After leaving the forest, the trees are then transported to a sawmill for lumber production or a pulp mill for paper production. In the case of the sawmill, the wood is transported to the facility where it is de-barked, broken down into smaller increments with a head saw, and then further broken down into the appropriate size and shape by an edger. Following that process, the lumber is then put through a drying process, either in a kiln or air-dried. Finally, the wood is planed, which conforms the lumber to a uniform size and shape. It is becoming increasingly common for many of these steps to be performed on-site with portable equipment to reduce the overhead costs of running these facilities.[13] Some of the largest sawmill companies in Georgia include:

- Georgia-Pacific
- International Paper
- Woodcraft

Pulp and Paper Mills

A pulp mill is a mill that converts wood or wood chips into pulp which can then be processed into paper at a paper mill or included in other products. Wood consists of three main components; cellulose, lignin, and hemicelluloses fibers. The goal of a pulp mill is to break the wood source down into the three components. There are three kinds of pulp mills, chemical pulp mills, mechanical pulp mills and hybrid chemi-mechanical pulp mills. Pulp mills produce thick sheets of pulp which will then be converted into paper by the paper mill. In Georgia, many pulp and paper mills are located in the same facility. [14] These types of mills offer the most likely candidate for CHP because of their high utilization of steam, recycling, and recovery processes already in place which will be explained in more detail in the next section. Some large pulp and paper mills located in Georgia include:

- Austell Boxboard Mills

- Georgia Pacific
- International Paper
- Weyerhaeuser Co.

Pulp, and Paper Process

In mechanical pulp manufacturing, small wood logs are ground down into "stonewood pulp" that is mostly used in flimsier products such as newspaper and paperboards. In more modern mechanical facilities, logs, as well as wood chips, are often steamed prior to the grinding process, which increases the efficiency of the pulp-making process[14]. Chemical pulp is produced by converting wood chips into pulp through a chemical interaction process. All chips come directly from mobile chipping facilities at the harvest site, or as a by-product from sawmills. Chips are delivered by truck and unloaded by large hydraulic dumpers. The chips are then sorted by size and quality and combined with chemicals inside the digester. The digester then heats the chemicals and wood chips are heated to soften the wood fibers, the main component of finished wood pulp. One of two chemical processes is then used to separate the lignin that holds the wood fibers together from the cellulose fiber itself. These two main chemical processes are the kraft and sulfite process. Kraft process uses sodium hydroxide and sodium sulfides to break down the wood, while the sulfite process uses salts of sulfurous acids. The lignin, commonly called "black liquor," is burned in a recovery boiler to generate steam and power. The pulp is moved through several screens to remove contaminants and then bleached using chlorine dioxide, hydrogen peroxide, and oxygen in preparation for papermaking. Lastly, a moving belt presses the pulp into a flat sheet, removing most of the water.[15]

Conversion of the pulp into paper involves the use of a papermaking machine which can be as long as two football fields (200 yards). The pulp web is inserted into the machine where water is extracted from the sheets. The paper is then dried by steam-heated rollers or can dryers and wound onto large spools which, when full can weigh up to 25 tons. They are then stored until shipped.

Recycling

Since nearly half the paper produced in the United States is from recycled paper, the processes involved such as de-inking, cleaning and fine-screening must be explored as well as a potential area for CHP application. When used paper enters a recycling facility, the paper is mixed with water and agitated in a pulping vat that creates a slushy substance. Chemicals such as peroxide and sodium silicate are used to encourage the re-pulping process. Screens are used to remove non-paper items such as staples or paper clips before the slush moves on to the de-inking process. The slush is mixed with soap and filtered with air and then removed through a chemical screening process. The recycled pulp is then mixed with fresh pulp, screened a final time and mixed with water to be fed into the papermaking machine described above. [16]

CHP in the Georgia Forestry Industry

The paper industry uses electricity to drive machinery such as fans, pumps, conveyors, and compressors. The largest users in pulp mills are pumps, which use 40-45% of the total power needs and fans which use 15-20%.[17]

Currently, CHP has been utilized in pulp and paper mills for many years. Recovery boilers have been in use since the 1930s to recover chemicals, create heat and produce electricity.[18]

The main function of a modern recovery boiler is to recover black liquor chemicals for reuse. The heat, which is a by-product of this function, is captured and used to produce high pressure steam which produces electricity in a turbine. This electricity can either be used by the facility or sold back to the electric company. The turbine exhaust, low pressure steam, is used for process heating. In many mills, as much as 40% of electricity is produced in-house along with cogeneration of steam.

The waste heat that is recovered comes from concentrated black liquor, which contains organic dissolved wood residue in addition to sodium sulfate from the cooking chemicals added at the digester. Combustion of the organic portion of these chemicals produces heat.

Since there is a fairly high amount of sulfur produced in the process, combustion in the recovery boiler furnace must be controlled very carefully to avoid the production of sulfur dioxide and sulfur gas emissions. In addition to energy-producing combustion, the reduction of inorganic sulfur must be achieved to prevent the production of these unwanted by-products.

The recovery boiler process consists of these processes:

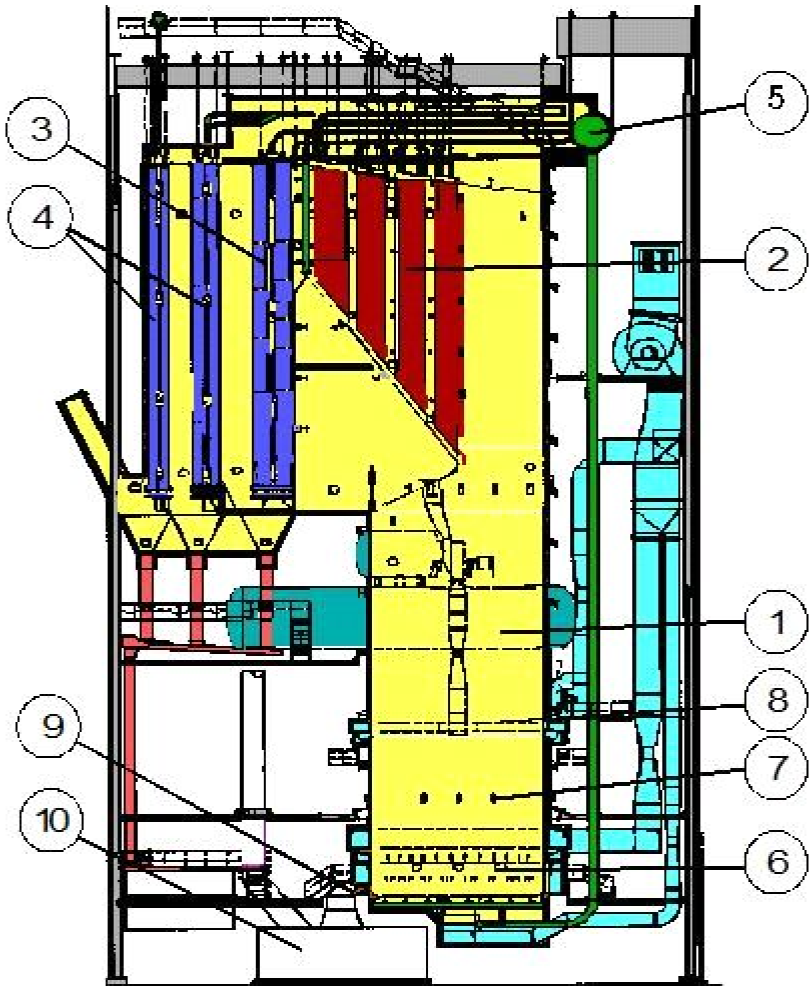
- Combustion of organic material in black liquor to generate steam
- Reduction of inorganic sulfur compounds to sodium sulfide, which exits as smelt
- Production of inorganic flow of sodium carbonate and sodium sulfide, which is later recycled to the digester after being re-dissolved
- Recovery of inorganic dust from flue gas to save chemicals
- Production of sodium fumes to capture harmful combustion residue of released sulfur compounds 19

Recovery Boiler Function

A recovery boiler is composed of what is called a single drum design, with vertical steam generating at wide spaced super-heaters. The high pressure and extreme heat of the steam produced makes it necessary to use superior materials in boiler construction to limit corrosion.

The steam flow increases when the black liquor dry solids content is increased. Heat is lost when there is a great deal of air escaping through the flue. The flue heat loss will decrease as the steam flow diminishes. Increasing black liquor dry solids is helpful in decreasing the exhaust flow through the flue which, in turn, increases the amount of electricity that the boiler can produce. The overall efficiency of the recovery boiler capacity is limited by the amount of steam flow.

Figure ##



A modern recovery boiler consists of heat transfer surfaces made of steel tube; furnace-1, superheaters-2, boiler generating bank-3 and economizers-4. The steam drum-5 design is of single-drum type. The air and black liquor are introduced through primary and secondary air ports-6, liquor guns-7 and tertiary air ports-8. The combustion residue, smelt exits through smelt spouts-9 to the dissolving tank-10.[20]

Recovery boilers typically operate at approximately 2,000°F and produce superheated steam for electricity production. The design of the boiler's air flow system is responsible for high maximum furnace temperatures. The average flue gas flow decreases as less water vapor is present in the black liquor dry solids. So the flue gas flow can be reduced even with increasing temperatures in the furnace.[21]

Historically, coal has been preferred over biomass because it generates between 7,000 and 12,500 Btus/lb. while biomass produces between 5,300 and 6,400 Btus/lb. With worldwide coal prices reaching an all-time high of \$97.24/ton[22] in the second quarter of 2008 compared to \$40/ton for wood waste, woody biomass becomes a more viable option.[23] A major barrier to wood and wood waste being used to generate power is that it is highly regional. A wood waste supplier must be relatively close to a facility in order to keep transportation costs low and maintain an economic advantage over other fuel sources. Generally, any transportation greater than 100 miles will not be economical. Another option for the industry is to use the wood waste to produce the cleaner, more energy-efficient biomass gas. Biomass gas is the gaseous fuel that is produced when any type of biomass is run through a gasifier. The energy produced by the biomass gas can range anywhere from 150 to 800 Btu/ft^3 depending on the make-up of the biomass being gasified, while natural gas produces roughly 1000 Btu/ft^3. Low-energy biomass gas is typically burned on-site to produce steam and heat for the facility. A major drawback to producing biomass gas for use as an energy source is the required purchase of a gasifier. Gasifiers extract fuel vapors from biomass that can be burned in a boiler to produce energy. The high cost of a gasifier, which can reach as high as \$3000/kW, makes the power output cost-effective in very large-scale operations. In the future, the cost is expected to fall in the \$400 to \$600/kW range, however this is still a significant amount that would not make the gasification system economical in a small-scale operation unless the application had access to a free fuel source.

Equipment and maintenance costs for CHP application All monetary amounts are \$/kW	
Biomass Gas	
Modify Existing Equipment	\$600-\$1000
New Equipment	\$1130-\$3130
Maintenance	\$0.005-\$0.021
Wood (Forest Residue)	
Modify Existing Equipment	\$140-\$420
New Equipment	\$700-\$1900
Maintenance	\$0.006-\$0.014
Wood Waste	
Modify Existing Equipment	\$150-\$440
New Equipment	\$740-\$2000
Maintenance	\$0.007-\$0.015

Combined Heat and Power Market Potential for Opportunity Fuels. Aug. 2004.

Georgia Forestry Industry Potential

Recently, the pulp and paper industry has begun facing plant closures and downsizing due to the slowing economy and its effect on demand for paper products. This is having a very negative effect on many communities across the country.[24] As a result, the forestry industry has escalated its interest in forest biomass as an energy fuel. Forest biomass is organic material that includes trees, brush and residue from wood manufacturing facilities. The Georgia Forestry Commission estimates that Georgia's waste wood, such as brush, ground waste, and unusable timber, has the potential to supply as much as 22% of Georgia's energy needs. One option being explored to revitalize the industry is transforming pulp and paper mills into bio-refineries, factories where alternative fuels can be produced. Two years ago, Georgia forest landowners and energy companies began discussions on how to increase development in this arena.[25] These mills can be fully transformed or modified into a pulp and paper/energy hybrid. Since transforming a mill into a full-scale bio-refinery can be extremely cost-prohibitive, with costs ranging anywhere from $50 million to several hundred million dollars, hybrid refineries may be the direction the industry is headed.

Georgia legislators have seemingly recognized this statewide trend. Last year, the state government passed a bill that would entitle business owners and residential customers to income tax credits if certain clean energy property criteria were met. The bill approves tax credits of up to $2.5 million through 2012 and applies to clean energy property including, but not limited to, "biomass equipment to convert wood residuals into electricity through gasification."[26]

Many Georgia utilities are beginning to see the value in wood and wood waste energy production as well. Last August, Georgia-based Georgia Power requested approval from the state to turn one of its coal burning plants, Plant Mitchell, near Albany, currently capable of producing 155MW/year to 100% wood power. The wood waste will be obtained from suppliers operating within a 100-mile radius of the plant and power over 60,000 homes. In September, Olglethorpe Power Corp. announced its intention to build three 100MW/year power plants by 2015 powered by chipped pulpwood, sawmill waste, and harvest residue.[27]

A study published by the U.S. Department of Energy's National Renewable Energy Laboratory, stated that biomass energy plants create up to 4.9 jobs for each MW of installed capacity – that's nearly 1,500 new jobs if all three of Oglethorpe's proposed biomass plants are developed. Each plant will provide up to 40 new full-time jobs on-site as well as employ hundreds more in the state's forestry industry, through jobs associated with harvesting, processing and delivering biomass for the plants.[28]

According to Greg Jones, Director of Public Relations for Oglethorpe, the motivation behind the creation of this plan was to develop a sustainable energy opportunity that would benefit Georgia's economy while being able to produce electricity at a "24/7 rate."[29]

The proposed Georgia power plants will utilize a steam-electric generating station consisting if conventional fluidized bed boiler/steam turbine installation. Mainly woody biomass consisting primarily of whole tree chips, chipped pulpwood, wood waste from sawmills and wood remaining in the forest after clearing will be burned at the plants. Each plant will consume approximately 1 million tons of wood per year based on an average of 85 percent capacity utilization. Additionally, each biomass plant will be developed on a minimum of 150 acres to both provide a buffer between the plant and community, as well as provide forests from which fuel sources will be harvested.[30]

This example shows how new power plants will be constructed to consume wood waste leftover by logging and construction activities. However, many lumber processing plants and pulp and paper mills are already using their wood waste to supplement their energy consumption because of the readily available fuel source at their disposal. Since they already are using the wood waste to supplement their own energy consumption, many operations could benefit from the proliferation of these plants. These types of facilities can turn their excess biomass into a profitable energy production by selling it to power plants like Oglethorpe is proposing.

This widespread interest in energy savings and a willingness in the industry to further explore biomass energy shows that there may be further opportunity for CHP in this arena.

Barriers to CHP Development

Several barriers prohibit the timely and efficient design, installation, and operation of CHP facilities. These barriers include air quality regulations, interconnection issues, the prohibition of third party sales of electricity, and utility rates. These barriers are not specific to CHP, but apply to most distributed generation projects. CHP does have a number of forestry-specific barriers. These include functional on-site productivity, the prevalence of recovery boilers, and capital intensive nature of installing CHP operations in the industry.

Air Quality Regulations

There are six criteria pollutants that the EPA utilizes as indicators of air quality. These pollutants include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead. For a detailed look at these various pollutants, please refer to the EPA's website Green Book at: http://www.epa.gov/oar/oaqps/greenbk/o3co.html

Hazardous Air Pollutants (HAP) adversely affects human health and the environment, resulting in cancer, reproductive defects, birth defects, etc. Currently, there exist 188 pollutants that the EPA defines as HAPs. Nine of these pollutants are related to CHP technologies including benzene, formaldehyde, naphthalene, and toluene. For a comprehensive list of HAPs please visit the EPA's website at http://www.epa.gov/ttn/atw/188polls.html

Limitations arise from the prohibitive unit costs of after treatment technology generally applied to larger installations. Standards for emissions limits from large installations are unsuitable for smaller CHP units, however these limits are erroneously applied to mass produced generation equipment, voiding the cost savings yielded from mass production. The savings from mass production are lost because of the high cost per unit of treatment technology. Improper emissions requirements often lend to the difficulty of a CHP installation and therefore should be carefully reviewed before the consideration of a CHP operation[31]**Error! Bookmark not defined.**.

Interconnection

When a facility installs onsite generation, there are typically three ways which that system may be configured in relation to the utility grid: isolated operation, isolated operation with utility backup, and parallel operation with utility system[32]. Installation of a system with utility backup or parallel operation may yield interconnection issues which pose a barrier to smooth and timely installation. Additional costs and lengthy installation schedules may result as an effect of interconnection boundaries. These barriers may be classified by two categories: technical barriers and regulatory barriers[33].

Technical barriers arise from the utility's requirement that CHP technology systems be grid compatible[33]. Utilities are generally concerned with issues of safety, power quality, equipment protection, and system control[32]. Typically, technical issues are addressed with thorough engineering analysis and costly equipment; however, this is sometimes unnecessary due to the already present safety devices included in the customer's generation system[33]. Comparable to expensive emissions equipment inappropriate for the small scale of CHP, mass production cost savings are reduced via the required equipment and analysis appropriate for a large scale installation where cost per unit is considerably less.

Regulatory interconnection issues also hinder the successful installation of CHP systems. Many states lack consistent polices, if policies even exist at all[34]. Georgia has adopted standards for residential systems up to 10kW and commercial systems up to 100kW. Interconnected customers must comply with all national standards: Institute of Electrical and Electronic Engineers (IEEE), Underwriters Laboratories (UL), and National Electrical Safety Code (NEC). Furthermore, the Georgia Public Service Commission (PSC) may adopt additional safety, power-quality and interconnection requirements. There is no provision in Georgia's interconnection standards requiring customers to install a manual external disconnect device. Utilities may not require additional tests or additional liability insurance.

Georgia Power, the state's largest utility, has established a green-power program, whereby the power generated by eligible renewable-energy systems connected to the grid under the utility's net-metering provisions is sold to other customers. System owners are paid for generation at a higher rate than the rate at which they would be compensated under standard net metering. Insurance and inconsistencies in regulations create a difficult problem for all interested parties when investigating final monetary costs and time requirements related to a CHP installation. As with technical interconnection barriers and air quality regulations, inconsistent regulations related to interconnection reduces the cost savings of mass manufacture.[35]

Utility Rates

Many CHP applications utilize the local utility as a source of backup power in the system design. But relying on the utility for backup power creates a large hurdle for CHP applications in Georgia.

Georgia rate structures outline certain charges that pertain to owning and operating private power production equipment. Charges known as “back stand” charges or “standby rates” are charges that the consumer must pay in compensation for the utility’s generating capacity. These rates apply to consumers that generate their own power, but still require electrical service from the utility intermittently. Periods of predetermined downtime of the consumer’s generation equipment, additional supplemental energy supply from the utility, and the use of the utility as backup power during unforeseen system downtime create the need for standby power[32]. Sometimes the standby rate can be a large enough expense to negate any financial benefit from a CHP system in effect hindering a peak shaving application[36].

There are 52 municipally run utilities in Georgia, but only one major utility company; Georgia Power. All have rate structures and riders that address standby charges, however, for convenience Georgia Power’s riders will be referred to in this document.

Several methods may be used to overcome unfavorable utility rates concerning the installation and operation of a CHP system. The CHP system owner/operator may take certain measure to reduce the negative impacts of standby utility rates. Changes may also be needed for utility policy concerning the application of certain rates related to a CHP or distributed generation project.

A CHP owner/operator may invest in multiple generating units as insurance against system outages. Then standby rates and insurance are purchased for only one of the units. Removal of standby charges and exit fees would be a best case scenario for advocates of CHP. Although this event is unlikely, certain steps may be taken by the utility commission to address prohibitive rate and fee practices. Increased testing and analysis should be placed on standby rates. This analysis may prove that exit rates and standby charges are unnecessary. Other rates are subject to a rigorous evaluation and standby rates and exit fees should be no exception. Public interest should also be considered when deciding standby rates. Environmental and economic issues that affect a community at large may outweigh utility profit and the goal of utility service should include society’s long term interests[37].

Forestry Industry Specific Obstacles

Functional On-Site Productivity

In the best possible scenario, CHP is utilized efficiently where there is a constant supply of thermal energy and a constant load for that thermal energy. However, the preprocessing functions in the forestry industry, such as felling, de-limbing, bucking, and loading take place out of the mill and in the forest itself. The forestry industry utilizes many portables devices such as gas-powered trucks, saws, wood chippers, de-barking and de-limbing machines. These types of operations do not lend themselves well to CHP processes as there is no practical functional way to capture waste-heat out in the actual forest site. For this reason, there is not much interest or need for CHP processes in what is traditionally referred to as forestry, such as felling trees and logging. Only by expanding the traditional view of the industry to back-end processes will we find areas that can benefit from CHP. Typically, the bark, limbs, branches and shavings are removed from the tree at the site, where they remain. Many logging companies do not see the value in gathering up the waste for sale or use at their facilities. As demand for these items as a fuel source increases, companies will be provided with new opportunities to expand their business model. They will begin to find activities such as collecting and transporting their wood waste quite profitable.

Recovery Boilers Prevalent
It will be difficult to determine additional widespread and practical applications of CHP in the industry due the prevalence of recovery boilers that already exist. The first recovery boiler was built in 1929, so energy efficiency and recovery has been a staple of the industry for over 75 years. In that time, the construction and operation of recovery boilers has improved to the point where in most large mills, up to 89% of waste heat can be recovered. The process efficiency of these boilers is significant and compares favorably with other industries. This efficiency represents a significant barrier in convincing industry stalwarts that additional CHP is needed. Further research into different areas of pulp and paper production is necessary to determine where there is an area in which thermal heat and/or energy is being lost at a consistent rate. However, the prevalence in CHP technologies already in existence is evidence of not only a longstanding history of desire for energy conservation, but also a willingness to further explore these types of technologies. The culture of energy, chemical and material reuse that is a staple of the logging and paper industries bodes well for future CHP opportunities in the industry.

Exploring Implementation of CHP

CHP technologies offer a potential opportunity to increase productivity and economic efficiency within the pulp and paper processes. As such, there are numerous government, trade, and support organizations for the implementation of CHP equipment.

The Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) offers *Quick Plant Energy Profiler (Quick PEP)* software on its website to help determine how energy is currently being used and where opportunity exists to save cost and energy. The Department of Energy also sponsors *Industrial Assessment Centers (IACs)* which provide no-cost energy assessments for small and medium sized manufacturing facilities.

The United States CHP Association (USCHPA) offers links under the resources section of its website including CHP software tools, CHP manufacturing company links, and national case studies for current CHP projects and technologies.

Conclusions

Under the direction of the United States DOE, the Southeast CHP Application Center has set out to develop market assessments for CHP with respect to specific industries within the southeastern states.

The Georgia forestry industry is a large, energy intensive, multi-billion dollar business that accounts for the employment of a significant portion of working Georgians. In Georgia, 67% of the state is covered by timberland, making Georgia a major potential source of woody biomass.

Energy costs account for approximately 3% of the value of finished goods in the forestry industry. At a national level, the forestry industry consumes 3.3 quadrillion BTU's of energy per year to make its products. Although the forestry industry initially appears to utilize CHP installations opportunities, there are several areas for implementation that continue to be ignored by a significant portion of the industry.

Opportunities for CHP installations do exist in many mills where potential energy sources are often ignored or discarded. The largest barrier towards the implantation of CHP in the industry is the high implementation costs associated with purchasing the equipment necessary to take advantage of the available biomass fuel sources such as wood residue, waste wood, construction and demolition waste and black liquor. For example, a gasifier, which would be required to implement the most efficient use of biomass fuels, can alone cost $3000/kW. These initial costs make it difficult for some to see the longer-term savings and benefits of CHP applications using frequently discarded biomass fuel.

Georgia Power, however, is moving forward with its plans to convert its coal-fueled Plant Mitchell to renewable wood biomass. They believe that the lower fuel and operating costs associated with a woody biomass plant, outweigh the initial conversion costs of this project. Biomass fuels that would normally go to waste are typically less expensive to obtain and usage provides tax credits in many states, including Georgia. As traditional fuel costs rise and incentive-based legislation passes, more utilities will begin to entertain projects such as this and Oglethorpe Power Corp.'s massive woody biomass development project.

Conventional barriers inhibit the installation of CHP in the forestry industry as well. Restrictive environmental regulations, prohibitive interconnection procedures, and prohibitive standby rates for electricity all present themselves as barriers for CHP installation. The forestry industry also faces more specific barriers such as mobile site-to-site energy needs and the current prevalence of recovery boilers. Difficulty in obtaining local industry data such as energy usage, production rates, and waste heat utilization manifest a barrier in the creation of a market assessment as well as CHP development in general.

Policy reformation and modification of federal, state, and local legislation, such as the clean energy credit bill that was just passed in Georgia, can work to overcome some of these barriers. Regulators, officials, and industry and utility representatives must work together to create sound, consistent policies and regulations that give CHP equal treatment in the world of power generation.

While CHP may provide a cost-saving, energy-efficient option for the forestry industry, change is slow to come due to the capital and energy-intensive nature of the industry. However, the availability of biomass in the industry at a relatively low cost is something that will not be ignored much longer.

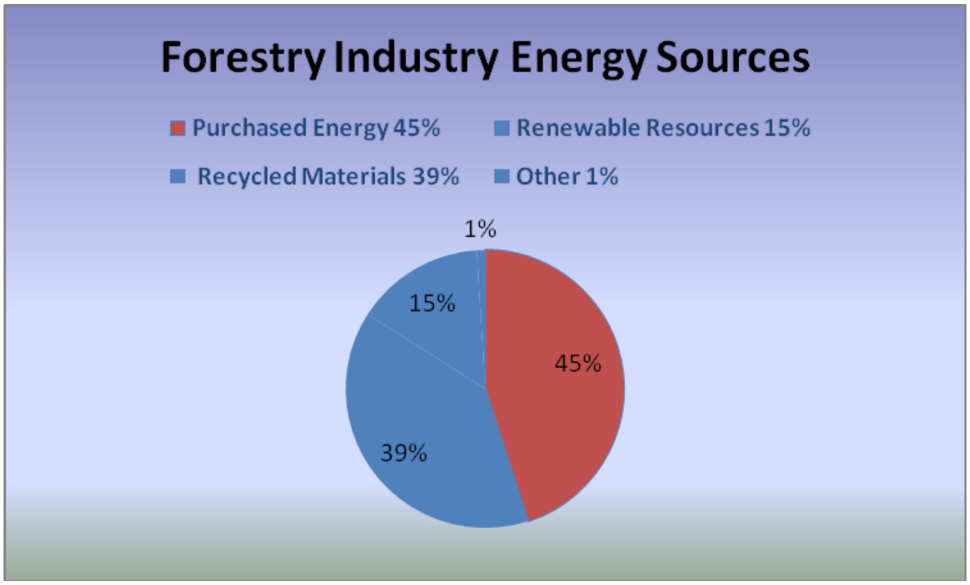
CHP implementation, as discussed within this report, is a cost-based decision that will more than likely coincide with government incentives, rising fuel costs or industry-wide adoption of hybrid mills which manufacture goods and produce electricity. The rest of the industry will be forced to follow suit in order to compete.

APPENDIX A

Forestry Industry Profile: United States

As identified by the US Department of Energy's Industrial Technologies Program, the Forestry Industry is comprised of "wood preparation and raw materials, pulping, bleaching, chemical recovery, papermaking, recycling, recovery, and emission controls." To simplify this, we can divide the forestry industry into two main segments: lumber and wood products, and pulp and paper products. The area of lumber and wood products consists of growing, harvesting, and processing wood and wood fiber.[38] As of 1997, this segment was a $103 Billion industry. The area of pulp and paper products consists of the manufacturing of pulp, paper and paperboard products from unused and recycled fiber. The United States produces 35% of the world's pulp and almost one-third of the world's paper.

The forest products industry consumes the third-most energy in the United States, behind only petroleum refining and chemical production. The industry consumes 3.3 quadrillion btu of energy per year to make its products. The industry compensates for some of its large amount of energy usage by self-generating over 54% of the energy it consumes through the use of renewable resources such as pulping liquor, bark, and wood. Even with that production, the industry still spends as much as 3% of the value of its shipments on energy, twice that of comparable industries. Waste recovery and recycling are also major sources of energy for the industry.[39]



(US Department of Energy)

Forestry Industry Profile: Georgia

Georgia currently ranks third in the United States and first in the southeast in total forest land area. For this reason, Georgia's forestry industry was chosen for a CHP market analysis. Forestry, a $25 billion dollar a year industry in the state of Georgia, is currently the leading industry in the state, making timber its most highly valued crop. Forestry industries account for 24% of total manufacturing output in the state. This is approximately $1 out of every $4 of output to the Georgia economy by manufacturing. Figure 4 shows the amount of value added to the Georgia economy. In relation to all manufacturing in Georgia, forest industries in 1990 accounted for 22% of the total value-added contribution. This is approximately $1 for every $4.50 of value added to the Georgia economy by manufacturing. Specifically, wood and paper processing is the number one earning value added manufacturing sector in the Georgia economy. Of $16 billion total manufacturing value added in Georgia, wood and paper processing earned $3.5 billion in value added directly, just slightly ahead of food products manufacturing.[40] Value added is defined as "the value of output minus the value of all intermediate inputs, representing therefore the contribution of, and payments to, production[41].

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