GEORGIA FORESTRY
COMMISSION

Developing Forest Resource and Biomass Markets in the South

Volume II: Mechanisms for Securing Long-term Forest Biomass Supply

March 2012

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Completed under contract for the Georgia Forestry Commission by:

BioResource Management, Inc.

Dougherty & Dougherty Forestry Services, Inc.

Preface

Successful bioenergy project development requires the application of an economically viable energy conversion technology combined with an assured feedstock supply and access to the energy market. Large bioenergy facilities can require hundreds of millions of dollars in initial capital expense for planning, permitting, and construction. This level of investment leads to a return-on-investment period of 10 years or more. Due diligence actions by project developers, investors, and financiers often include formal agreements for feedstock supply. This report addresses alternative methods to procure forestry biomass in the long term.

Over the past seven years, the Georgia Forestry Commission has provided assistance to over 300 prospective bioenergy companies. Most of the Commission services have involved one-to-one contact and tailored information for each company based on their specific needs. Many companies express a desire to enter formal agreements with biomass suppliers and are unclear on the possible provisions, opportunities, and limitations of the forest products supply chain as it relates to forestry biomass. While not completely blocking bioenergy development, the issue of supply agreements has become a large hurdle in many areas where the majority of timberland is owned by non-industrial forest owners. As part of a larger project in 2010, which was partially funded by the U. S. Forest Service State & Private Forestry, the Commission began to develop a strategy that would address the supply agreement hurdle.

Volunteers representing fourteen organizations in the forestry community met with Commission staff to discuss and develop an outline of issues that should be addressed in educating companies on biomass supply procurement. Landowners, forestry consultants, loggers, university research staff, and company employees were all represented in the advisement committee. A strategic plan was developed. The Commission engaged BioResource Management, Inc. to develop the strategic plan into a useful forest biomass sourcing report entitled ***Mechanisms for Securing Long-term Forest Biomass Supply.***

Supply agreements involving landowners and wood dealers are addressed in some depth. Possible use of timberland leases and timber deeds are also included. Management of various types of risk is discussed throughout the report with a risk overview provided near the beginning. It is not the intent of the Georgia Forestry Commission to recommend the use of any specific form of long term supply agreements. Nor do we recommend or discourage the use of long term supply agreements in general. It is our hope that this document will provide insight into the usefulness of long term supply methods in various situations where they are needed, as well as listing potential advantages and disadvantages of using the various methods described.

Nathan McClure
Utilization Department, Georgia Forestry Commission

Notice

This volume is part of a series of technical reports designed to assist with the development of forest resource and biomass markets in the southern United States. The volumes and their intended purposes are as follows:

Volume I: An Overview of the Timber and Biomass Supply Chain
Volume I describes the general organization and operation of the typical forest resource supply chain for those with limited knowledge of forest-based industries.

Volume II: Mechanisms for Securing Long-term Forest Biomass Supply
Volume II explores alternative methods to providing long-term assurance of forest resource feedstock deliveries to a mill.

Volume III: Biomass Designation and Tracking for Renewable Biofuels Production
Volume III suggests methods that lead to compliance with the Renewable Fuels Standard established by the Energy Independence and Security Act of 2007. It is also useful to those establishing procurement systems that document sustainability of the forest resource.

Disclaimer

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This report is not intended to provide constraints, agreements, or encourage concerted actions that may restrain competition, set prices, or any way violate antitrust laws. The Georgia Forestry Commission and the federal government do not recommend the use of any specific form of biomass procurement or transaction. The information provided herein presents a partial list of the various alternatives to meeting individual company goals and requirements.

Acknowledgements

The Georgia Forestry Commission wishes to express appreciation to those individuals and organizations contributing to the development and review of this report, including the following:

2010 Georgia Biomass Supply Development committee
BioResource Management, Inc.
Dougherty & Dougherty Forestry Services, Inc.
Dru Preston, Georgia Forestry Commission Utilization Department
Georgia Forestry Commission Communications Department staff
U. S. Forest Service State & Private Forestry

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1. Introduction

Traditional wood procurement systems for forest products facilities evolved over the past 50 years - from owning their own land base and logging crews, to contract logging on company land to selling land in exchange for long-term fiber agreements. Today, nearly all forest products companies rely upon wood procured from either landowners under long-term agreements, dealers and producers under shorter term agreements, and 'gate wood,' or wood obtained via spot market purchases.

Emerging bioenergy companies generally do not have the luxury of owning sufficient land for a captive long-term supply, and yet they must secure a reasonable portion of their needed materials under contracts that are enforceable, and therefore secure, for financing purposes. The following discussion describes the mechanisms that may be useful to potential bioenergy facilities in securing a stable and reliable biomass supply obtained from Georgia's forests.

2. Biomass Supply Contract Overview

The parties of a biomass supply contract include two types of entities: landowners or their representatives, and timber dealers. Generally speaking, large landowners are in a better position to execute multi-year biomass supply agreements directly with biomass facilities. Other landowners may not have sufficient volume on hand to make annual commitments of sufficient scale to assist in financing the facility, and may lack the flexibility in harvest decision-making that large landowners have. Large landowners may include timberland real estate investments trusts (timber REITs), industrial timberland owners, nonindustrial timberland owners, and timberland investment and management organizations (TIMOs) that represent landowner-investors including pension funds and insurance companies. Timber dealers are effectively brokers between timberland owners and wood consuming facilities, and as a result afford the biomass facility opportunity to source material from landowners across the scale from small to large. Dealers may contract harvest and transport operations to third parties, or they may be loggers themselves and sell directly to wood using mills.

In either case, the landowner or dealer is looking for a stable market, premium price for his product, and flexibility to catch market highs and avoid market lows if possible. Alternatively, the buyer of the harvest or biomass rights is looking for a low price and consistent stream of biomass of certain size, quality, and moisture content. The biomass supply contract works to merge the interests of both parties via a set of relatively standard provisions adjusted to the particulars of each case that seek to provide the needed revenue or good while avoiding or mitigating a host of risks. Biomass supply contracts can assume a number of different forms,

ranging from land lease agreements to dealer supply contracts, each type appealing to different situations confronting the biomass producer and consumer's specific circumstance.

Standard contract provisions and common risks faced by biomass consuming facilities are introduced in the next section, and further details are presented in subsequent sections covering specific types of contract structures.

Contract provisions

Biomass supply contracts consist of a series of provisions, many of which have similar meaning and content regardless of the type of supply agreement established by the contract. A number of such common biomass supply contract provisions are introduced below, while provisions that are particular to the different types of supply agreements are contained in the discussion of each supply contract type. *NOTE: this discussion is meant to provide an overview and is not to be considered as legal opinion.*

Term. While some supply contracts are routinely executed for periods of one year or less, only contracts of five or more years are discussed in this report. Contract term establishes dates of initiation and termination of biomass deliveries. Renewal can either be upon mutual consent, or under an "evergreen" provision. Under an evergreen approach, either party must inform the other of its intent *not to renew* by a certain date during the initial term, or the contract is automatically extended an additional year. Such an arrangement can in a sense become a perpetual contract as long as neither party objects to an extension.

The term is often dictated by the financing mechanism used. If third party debt represents a significant portion of the total project financing package, lenders will often require longer term agreements. If a project is financed through net worth of the owner, they often will have different requirements for delivery volumes and contracts with shorter term and more opportunity for pricing adjustment based upon changing conditions in the marketplace.

Unit of measure. Wood transactions have often historically been conducted in volumetric units such as cords, cubic feet, or board feet. Today, the industry compensates suppliers in terms of green tons for many products, and in most bioenergy transactions at present, compensation is based on as-received weight with a standard for maximum moisture and ash content.

Drier fuel is desirable for biomass facilities employing thermochemical conversion processes such as combustion or pyrolysis, and as a result, such facilities may wish to compensate suppliers on a dry weight basis. That is, suppliers are compensated for the quantity of delivered dry mass, often expressed as oven dry tons or bone dry tons, indicating the mass of material at

0% moisture content. For example, a wood delivery with a 45% moisture content priced at $40/dry ton is compensated at $22/as-received ton.

Dry weight compensation is not the standard in the Southeast, and requires sampling of delivered loads of biomass to establish moisture content and appropriate compensation, but it is generally understood by suppliers once sampling and testing protocols are detailed. Suppliers compensated on a dry weight basis do have an opportunity to improve their profitability in some circumstances in which they are able to allow material to be stockpiled and air dried for even a few days. The value of each delivered load is then increased, and the supplier can realize a savings on freight costs. Facilities utilizing biochemical conversion pathways such as fermentation or digestion are generally less sensitive to moisture content in delivered biomass, but nevertheless, no facility wants to pay for water, and no producer wants to transport worthless material. As a result, dry weight pricing may be attractive to these types of facilities as well.

Some types of facilities may consider compensation for biomass material in terms of its energetic content; for example delivered British thermal units (Btu). Because Btu measurement requires specialized equipment, it is relatively less tangible and may be less appealing to suppliers (suppliers can verify a facility's moisture content readings on their own with a low-cost drying oven), who have little or no control over the energetic content of their fuel. Furthermore, the energetic content of dry biomass often does not show wide variation, and as a result, pricing based on dry weight closely parallels pricing based on energetic content. It may be more practical to build energetic content into biomass contracts in the specification provision discussed below by requiring a minimum level, with periodic testing to ensure compliance.

Quantity. This is usually expressed as a base quantity of biomass deliveries over a period of time with tolerances; for example, an annual quantity of 50,000 dry tons with monthly deliveries of 4,167 dry tons, and perhaps an annual tolerance of ± 5-10% and monthly tolerance of ± 10-15%. Shorter term tolerances tend to be wider because disruptions such as equipment breakdowns can derail supplier productivity or facility demand for as much as a week. This type of short disruption can be compensated for by modest increases in deliveries during subsequent months to satisfy the tolerance on the annual quantity. If deviations from short-term tolerances occur, the quantity provision may include mechanisms for notice of quantity adjustments during upcoming periods, if adjustments are of significant scale.

Biomass specifications. Biomass users should outline a number of carefully considered biomass attributes that suit their conversion technology and are within technical and logistical reach of suppliers. Correct specification is critical to project development, since problems have arisen in the past due to inconsistencies in particle size or moisture content specifications established with the biomass suppliers versus those understood by suppliers of facility equipment, such as in-feed conveyors or combustion boilers. While the biomass specification may not directly apply to

material specified in timber deed or land lease contracts, the biomass facility may well engage another party for harvest and processing of the material. As a result, biomass specifications are equally important in those contexts and should be contained in any contract with supply chain parties responsible for processing biomass into useable form.

The biomass specification will almost always include some version of the following attributes:

a) *Source material*. The words 'wood' or 'biomass' have many meanings, and the contract should clarify acceptable material; defining which materials are excluded is as important as listing those that may be included. A common component of this specification is the nature of the material. This may include individual species or species groups, such as hardwood or softwood. The material can be described as logging or site preparation residues or whole tree chips. Source will also likely identify the geographic origin of the material, either specific tracts or in terms of a range of freight distances to the facility.

b) *Particle size*. Particle size is a function of the conversion facilities' material handling equipment, such as conveyors and the conversion technology itself, as well as the capabilities of in-woods processing equipment. Particle size is generally specified in sieve or screen sizes and can also be quantified using methods approved by ASTM standards. It is specified as variants on particle dimension measurements, with upper and lower boundaries.

Three recent examples of specifications and supply implications from the Southeast:

- A biomass facility issued a supply agreement for material suitable for digestion and fermentation. In that agreement, particle size distribution was specified such that at least 99% by weight would have particles no greater than ½ inch in any dimension, with no particle greater than 2 inches in any dimension. The test for compliance was a standard sieve analyzer used in laboratory sampling. Zero tolerance on the larger particle size was problematic for field operators, and the specification was changed to less than 0.5% by weight of oversized pieces and no piece larger than 4 inches.
- A biomass cogeneration facility using a stoker grate boiler specified that no particles could exceed 4 inches in any single dimension. The facility then determined that pine needles could technically cause rejection under this provision, and the specification was subsequently changed to 95% of all material passing through a 3 inch screen with no particle having any dimension greater than 8 inches.
- A bioenergy facility used the term 3 inch nominal as its standard. This was specified such that at least 95% by weight of the material will pass through a vibratory screen with round holes 2½ inches in diameter, and no particle will exceed a single dimension of 7 inches. The facility also imposed a low-end sizing provision, limiting particles less than 1/8" to less than 20% by weight of the material. The specification was developed to ensure effective operation of their material handling system, and employed a characterization material would flow freely in their handling system.

c) *Moisture content*. Even if the facility is paying for biomass based on a dry ton basis, there are nearly always parameters of moisture content within which the plant must operate. For example, standard combustion plants cannot normally handle wood with moisture content greater than 65-70%, depending on the fuel's higher heating value, stack emissions temperatures, and other factors. Likewise, emission control equipment is designed based upon a certain exhaust, or stack, temperature, and if the biomass is excessively dry, the stack temperature may exceed the limits of the design.

d) *Contamination*. The presence of non-biomass material can be addressed in different ways. While forest-sourced biomass is generally cleaner than other materials such as urban-sourced material, contaminants such as soil can become entrained in the fuel if proper care is not taken by the supplier. If the contamination attribute is specified as a maximum ash content and evaluated via proximate analysis, for example, the facility should understand this ash content will include both contaminants and the mineral fraction of the biomass itself.

e) *Other specifications*. Other biomass attributes may be important, depending on the biomass facility. For example, material may be limited to percentage of bark, seed, or decomposed material content. Fermentation facilities may specify the species of material or even the age (and therefore chemical composition) of the material.

Compensation. The mechanism for which the supplier is compensated by the biomass facility is based on delivered quantities and the attendant unit of measure. Compliance with specifications and other criteria such as ash content are also important provisions to the supplier and may result in acceptance or rejection of material, or adjustment of the price. The compensation provision should provide details about payment method, terms, and documentation. Payments for delivered biomass contracts are typically made within one or two weeks of receipt of material without requirement for the supplier to invoice the facility. Payments for land lease or timber deed contracts may be either at the beginning of the agreement, annually, or monthly.

In most agreements with a term longer than one year, there are mechanisms that allow the pricing to be adjusted to reflect production cost and marketplace movements. In order to be effective and acceptable to both contract parties, adjustment mechanisms should be implemented with information generated by reliable and unbiased third parties. Governmental agency reporting as well as forest product price reporting services are typically utilized for this purpose.

For wood suppliers, generally three components of their pricing are the most important:

- *Stumpage prices*. Stumpage price refers to the value of standing timber. While of particular concern to wood dealers who must bid on timber sales, landowners also wish to receive competitive pricing for their product. Stumpage prices can be adjusted according to publicly available stumpage price reports for the region, such as Timber Mart South or Forest2Market. These reporting services are not limited to stumpage prices. They also provide periodic reporting on delivered prices, which in turn reflect the diesel and other costs discussed below. Reports on the individual harvest and freight cost components are also available.

- *Diesel fuel prices*. Diesel fuel, both off-road and on-road, accounts for a significant portion of a producer's expense. Indices for fuel prices by region are readily available; for example the U.S. Energy Information Administration publishes weekly regional reports. There are a number of ways that contracts can incorporate diesel price fluctuations, and given the volatility of diesel fuel prices, this adjustment is typically made more frequently than others.

An example of diesel fuel adjustment in the freight component of a contract:

For many years, the price of diesel fuel more or less followed inflation. In the early 1980s, this began to change, and businesses with large exposure to diesel fuel suffered significant losses. The first effort to alleviate this was a fuel price adjustment, or surcharge, and this is still being used by many trucking companies today. Buyers of transportation services, however, noted that often the surcharges were not consistent with fuel price fluctuation, and instead became a mechanism for rate increases in many cases.

In a project using both fuel oil and biomass trucking services in 2000, the surcharge was added by the current trucking vendor. Because fuel prices had dipped and the current trucking company would not reduce the surcharge, negotiations were started with other trucking companies. A mechanism was developed by which the cost per mile was quoted based upon the current local cash price for diesel. For each mile of freight, the price per mile was adjusted (up or down) based on the change in actual local price for diesel, adjusted weekly, at the rate of one-fifth of the actual change in the price per gallon being assessed per mile (based on average usage of five miles per gallon). This mechanism worked successfully, and the trucking company merely submitted a receipt for the diesel purchase and the receipt was used for the adjustment.

- *Other production costs*. Many other costs are incorporated into a final delivered price for biomass, including items such aswages, materials, equipment, and insurance. Movements for these costs generally reflect inflation, and can be periodically adjusted by referencing the producer price index (PPI) or the consumer price index (CPI), both reported by the U.S. Bureau of Labor Statistics.

Termination. The mechanisms by which either party may terminate generally are related to non-performance of other parts of the agreement (termination with cause). This provision usually includes the method of notice to non-performing party and some relatively short period in which to come into compliance (right to cure). Termination due to bankruptcy is usually included, as the bankruptcy court may terminate any agreement not judged to be in their best interest.

Some contracts also may include a provision contemplating termination without cause, or "termination for convenience," by one of the parties, usually the buyer. Facilities employing unproven technology use this as a limit of liability in the event their technology fails or markets change and they are forced to close for a period of time. If termination without cause is included, then the non-terminating party is usually, but not always, compensated in some way for the termination.

If termination without cause is included as a provision, this makes the contract effectively unenforceable. Many local governments require this provision in a variety of multi-year contracts, arguing that local officials cannot obligate their electorate for a period longer than their term in office. In more than one actual case in the Southeast, counties and cities have inserted the provision and then terminated three or five year agreements for biomass disposal after less than one year, because they received a more attractive offer from another contractor.

Remedies and defaults. In any contract, the provisions for what happens in the event of non-performance (other than termination) becomes the strength - and therefore the value - of the contract to either the buyer or the seller. The discussion here provides some guidance, but legal counsel is essential for review of these provisions.

The most common form of non-performance is non-delivery or non-acceptance. In many contracts, the notion of put-or-pay / take-or-pay is often included. This can be summarized as follows:

- If the Buyer can accept and the Seller can't deliver, then the Buyer has the option to source the volume of non-delivered material from somewhere else and charge the Seller the difference between the cost of the replacement material and the contract price of the equivalent material from the Buyer (Put-or-Pay).

- If the Seller can produce and the Buyer can't receive, the Seller has the option to market and sell the material to other markets, and charge the buyer the difference between the received price and the contract price (Take-or-Pay).

Sustainability standards and source restrictions. Concern about land use and environmental impacts of the developing biomass industry have resulted in sustainability standards and restrictions on biomass utilized to generate electricity or liquid fuels. For example, three bioenergy facilities in three different states that are currently under construction have restrictions on the type of biomass they can source to generate electricity. The renewable fuels standard resulting from the Energy Independence and Security Act of 2007 also imposes restrictions on liquid fuels such that only 'renewable biomass' can be utilized to produce renewable fuel. In this case, renewable biomass has a relatively narrow definition, eliminating much biomass occurring in the landscape. Sustainability standards might also place restrictions on whether or which non-native species can be used for biomass production.

In order to address these constraints, supply contracts are increasingly including provisions to ensure compliance with the restrictions imposed on a facility's off-take, be it a bioenergy or biofuels facility.

Force majeure. A clause in many types of contracts related to unpredictable events, the French term literally translates to irresistible power, and is usually described as an event that is the result of elements of nature or social disruptions such as civil unrest or war. Force majeure treats events outside the control of contract parties that cannot be avoided through the exercise of due care.

Sustainability standards case study:
A bioenergy facility currently under construction is being developed by an independent power producer under an off-take agreement with a municipal utility. The Florida project has minimum sustainability for forest-sourced biomass written into the power purchase agreement. The requirements of the sustainability standards include:

- Compliance with state silvicultural best management practices
- Prohibition on sourcing biomass harvested during conversion of natural forests to plantation forest
- Confirmation that landowner has engaged a professional forester to ensure compliance with the standards
- Prohibition on the use of stumps as biomass fuel
- Prohibition on use of invasive species, except as part of a restoration plan
- Landowners must replant tracts undergoing final harvest within 3-year period
- Annual sustainability seminars for suppliers
- Chain of custody documentation for all delivered loads

Force majeure example scenarios:
The finer points of force majeure provisions require legal interpretation that is beyond the scope of this document, but a few examples serve to illustrate some of the issues that can arise in practice. For example, consider the biomass fuel exporter confronted with lack of access to shipping vessels due to tropical storm activity. This may not be interpreted as a force majeure event as the facility should have foreseen the possibility of the event and planned accordingly.

Another example demonstrates the failure of a dedicated short rotation woody crop due to severe drought and resulting failure to deliver the contracted biomass quantity. It could be argued that the drought was of extraordinary severity, as in one real case in which extraordinary was considered a drought that occurs no more than once every 100 years, and as a result was classified unforeseen, unmanageable, and therefore, a force majeure event.

In most biomass supply agreements, performance requirements may be suspended for the duration of the event by the party declaring the force majeure event. In this case, the provision can be constructed such that if the force majeure event exceeds a certain period of time, the party not claiming force majeure has the right to terminate the agreement, and possibly incorporating the ability to recover direct costs associated with the event. Force majeure events triggering an ability to terminate the contract are typically three to six months in duration.

Risk, uncertainty, and mitigation

Biomass consumers are confronted with a number of risks when entering into long-term biomass supply contracts. The array of risk factors all contribute to two central concerns of the biomass facility: that biomass ***prices*** will increase to unsustainable levels, or that the facility will not be able to source sufficient ***quantities*** of suitable biomass. Factors contributing to both concerns along with possible means to mitigate those risks are summarized below.

Production cost uncertainty. Production cost is the sum of financial resources dedicated to establishing, growing, harvesting, processing, and transporting biomass material. That is, production cost includes the costs associated with all the various components of the biomass supply chain. Production cost uncertainty, then, is the potential for any important costs in this chain to experience a significant increase. Labor, insurance, equipment, timberland values or rental rates, and a host of other components contribute to production costs, but the greatest source of production cost risk for the biomass facility is the cost of fossil fuels. One need not spend much time talking with a logger before this becomes apparent. This is because fossil fuels are particularly volatile and are embedded in all parts of the supply chain, from diesel fuel used by machinery to prepare sites for planting, to fossil fuels used in the production of fertilizers and other inputs, to the diesel fuel consumed by harvesting, processing, and trucking biomass.

To put this in perspective, for only a portion of the supply chain, at current prices, diesel fuel accounts for approximately one-third of harvest, processing, and transport costs. A 25-35% increase in diesel fuel prices, far from a rare occurrence, thus increases these components of the overall production cost by 8-11%. Loggers in the region are acutely aware of the impacts of fluctuations in diesel fuel prices that can quickly erode profit margins, as in many cases they are at best only partially compensated for these price movements in their off-take markets. While the exposure of the biomass consuming facility to the impacts of fossil fuel price fluctuations is not the same as for actors within the supply chain, the facility does rely on participants such as loggers whose exposure will ultimately influence the cost of delivered biomass material.

Production cost risk not related to fossil fuel price movements can in large part be controlled by establishing appropriate cost adjustments over the life of the contract. That is, most of these types of costs incurred by the supplier will track inflation that can be indexed and adjusted in

contract pricing periodically. Inasmuch as the price of biofuel facility outputs is likely to move in step with fossil fuel pricing, they are in a sense self-mitigated from this risk. Other facilities do not have this advantage and find themselves in league with many other industries in their exposure. If bioenergy facilities, for example, are unable to negotiate a fuel cost pass-through to the end user in their off-take agreement, then they may examine such measures as purchasing oil or diesel futures or long term fuel purchase contracts, as do some other industries. Implementation of such a strategy is complicated by the fact that the biomass facility itself is not the direct user of the fuel.

External demand uncertainty. Biomass consuming facilities compete for raw material with other users to at least some degree, and external demand uncertainty refers to the uncertainty in future prices for woody biomass material resulting from this competition. That is, the more users of biomass material, the more likely it is that delivered biomass pricing will increase, so long as the overall supply of biomass in the region remains constant. In recent years, this has not been a large concern because many large users such as pulp mills have been shuttered with attendant drops in fiber demand. However, going forward it stands to reason that the Renewable Fuel Standard (RFS2), changing global prices for wood products, or other drivers such as renewable portfolio standards will increase the potential for fiber competition.

External demand uncertainty manifests itself as delivered biomass price volatility, and the mechanics of price movements are worth considering. Increasing demand for woody biomass or conventional roundwood products does not affect the cost of harvesting, processing, or trucking wood to the consuming facility. One could envision a scenario in which logging crews or haulers are in short supply, but this type of supply chain circumstance is only fleeting, as the industry has the ability to scale up by adding crews and equipment in a matter of months. This is furthermore a minor concern to biomass facilities under development, as their construction timeline will allow plenty of time for the local supply chain to adjust in advance of the facility's first deliveries. What cannot be quickly adjusted is the quantity of standing timber in the facility supply shed. This is where increased wood demand meets what is effectively a fixed supply in the short to medium term, and the competition for the fixed resource may lead wood consumers to bid up the stumpage prices paid to landowners for the purchase of their standing timber. Because stumpage prices can account for 10% to as much as 40% of the delivered price of lower-value wood products, including biomass, the potential for stumpage price escalation is important for biomass facilities to monitor.

Clearly, one method to mitigate this uncertainty is to execute biomass supply contracts with a fixed pricing structure. Fixed price contracts will likely be difficult to execute with timber dealers, as they are exposed to the stumpage price fluctuations described above. Likewise, timberland owners may have expectations of stumpage price increases going forward, and are unlikely to forego the opportunity to benefit from such market conditions. None of these rules

out fixed price contracts, as both dealers and landowners may be willing to agree to this type of structure if the price is high enough that it accommodates their expectations of stumpage price increases over the term of the contract. This may elevate prices to an unsustainable level from the perspective of the biomass facility, however.

Biomass supply agreements that have price adjustments tied to movements in the timber marketplace are an alternative that can help protect dealers and landowners. Linking delivered prices can be achieved by incorporating adjustments based on reporting services such as Forest2Market or Timber Mart South. The ability to adjust to the marketplace can benefit the facility due to lower delivered pricing, but contract prices are subject to increases over the term of the contract. Land lease agreements also may insulate facilities from market price fluctuations since the material does not enter the marketplace and the biomass facility itself has title to the material as it is produced.

Biomass crop risk. Biomass crop risk comprises both catastrophic losses to biomass crops due to fire, storm, or pathogen damage and lower than anticipated yields from timberland or dedicated feedstock crops.

Severe pathogen infestations or forest fires can cause dramatic financial losses to forest landowners or timberland lessees. Dead, standing timber rapidly degrades in the Southeast, thus limiting opportunity for salvage harvests of products suitable for traditional roundwood markets. Likewise, storm events such as powerful hurricanes can render large expanses of standing timber unmarketable for most traditional products. Clearly, biomass consumers have more flexibility to utilize damaged timber, so exposure is inherently lower than for traditional consumers. In fact, catastrophic events may present favorable biomass procurement opportunities for some facilities, but facilities relying on particular species or specifications can suffer the consequences of fire or pathogen damage.

Good silvicultural management practices resulting in vigorous timber stands can in large part insulate against significant pathogen outbreaks, and good site management to maintain fire breaks and the like can protect timber from damaging fire in most cases. Genetic improvement in tree species in the Southeast has resulted in improvements to productivity and resistance to some pathogens, but at the same time has somewhat narrowed the genetic base. In the extreme, clonal planting stock is being brought to market for some short rotation woody crops, and while this has the advantage of a consistent and uniform crop, reliance on a single genotype or single clone can expose the entire crop to the appearance of a single damaging pathogen.

Distributing sources of biomass supply as widely as possible within a facility's supply shed can help manage the risk associated with fire, pathogens, and storms since these events have footprints that are very unlikely to affect a facility's entire supply area. Diversification of

feedstock sources across a range of tree species and material types (roundwood, residues, etc.) also can insulate a facility from damaging pathogens affecting single species. Finally, insurance policies that cover standing timber losses due to storm, theft, fire, and similar events may be a viable alternative in some circumstances.

Counterparty risk. Biomass supply agreements have the objective of stabilizing the provision of raw material from the marketplace, and in the event that the counterparty to the agreement fails to perform, the facility is exposed to both price and quantity uncertainty. This is generally of greater concern in dealer contracts than it is with other types of contracts such as large landowner agreements or lease agreements.

In the event that a dealer fails to perform, the facility may find itself in a compromised position in which it needs to replace the quantity under the dealer's contract. The source of this replacement material will likely be from other suppliers who are aware of the contract nonperformance, and who may either be reluctant to engage in a supply agreement, or may sense greater bargaining power in the contract negotiation.

The best way to control counterparty risk with dealer supply contracts is to select reliable dealers with a proven performance history. Loggers are involved in the relationship, either as dealers themselves or as producers of material under dealer contracts, and understanding their cost structure and sources of risk goes a long way toward ensuring workable and stable contracts. Performance bonds can also be built into dealer contracts. In a sense this provides insurance against default with dealers who don't have sufficient assets to backstop their supply agreement. Performance bonds are somewhat common in the industry, and although some suppliers may be unable to obtain large bonds, many have utilized them in the past because government contracts often require them. Performance bonds, however, may handicap the ability of the supplier to access sufficient credit they may need to purchase new equipment if needed.

The counterparty to the supply agreements generally understand that if they fail to perform, they will be put out of business. It is important to identify the entity executing the agreement, and understand the relationship with this entity and current or past operations, as some producers may want to set up subsidiaries to perform the agreements. This should be acceptable to the biomass facility, provided the contract is guaranteed by the parent company or owner of the entity.

Regulatory uncertainty. Entering into a long term supply agreement in the past has generally not exposed the lessee to a high degree of regulatory or policy risk. Lately, however, the timber industry increasingly operates in a climate of stricter regulatory policy and oversight, many pertaining to environmental matters. Regulatory risk can translate into either increased

production costs via costs associated with compliance or constraints on biomass availability by restricting the utilization of some sources as feedstock material.

Depending on the contractual parties, regulatory risk could have a measurable effect on the lessee, deed holder, landowner, or logger. For instance, if the government passed a ruling requiring a permit for construction of in-woods roads or a permit for all herbicide or fertilizer applications, then the cost of doing business would increase and the overall production cost would likewise increase. Regulatory changes can affect output quantities from the woods as well. For example, should a lessee enter into an agreement in a particular watershed where the state government subsequently imposes harvest restrictions on a 100-foot buffer along all rivers and major tributaries, this could have a significant effect on harvestable volume on some properties.

Maintaining a clean operating record of compliance with the current regulatory environment may help with regulatory relations going forward. Facilities can also proactively engage regulatory and environmental entities to ensure a voice in potential or impending regulations either directly or via industry interest groups. Most agreements also have force majeure provisions that address adverse changes to laws or regulations, and it's important to understand what these may do to impact the cost of material.

3. Contracts with Large Landowners

Description, parties, and provisions

The basic biomass supply contract with large landowners is relatively straightforward: an agreement to supply a given quantity of delivered biomass to the facility for a specified number of years, with payment for material made upon delivery. Alternatively, the agreement could be for standing timber, with harvest and freight left to the biomass facility. Supply agreements of this sort have historically been in terms of 5 to 20 years, and annual quantity commitments can be as high as a half million tons or more. Many current fiber supply agreements are carryovers built into sales of timberland tracts over the past few decades from forest industry holdings to entities such as TIMOs and REITs.

If the minimum annual quantity of interest to the biomass facility is 25,000 tons, for example, then a landowner with as little as 2,500 acres could be in a position to execute such an agreement for a term of 10 years. This, however, assumes an aggressive pine growth rate on the property, and also assumes that all the output from the property is dedicated to biomass production, both the roundwood and residue fractions. It is unlikely that both conditions will be satisfied for any given property, as productivity within a property is usually not uniformly high and landowners will, in most cases, market a variety of traditional roundwood products jointly with biomass products. If a landowner is interested in marketing only residual material as biomass, given a

residue generation rate of 5 to 10 tons of residue per acre, then the landowner would need to be conducting harvesting operations on 2,500 to 5,000 acres each year. As a result, biomass supply agreements covering just residual material can only be executed with landowners who have holdings of at least 50,000 acres or more.

Under this type of structure, when the contract calls for delivered biomass, the landowner may operate his/her own logging crews or contract the harvest, processing or freight of the biomass material to another party. In either case, the contract is between the biomass facility and landowner, and the landowner is responsible for ensuring that deliveries are made according to schedule and specifications. If it is a stumpage contract, i.e., the purchase of standing timber, either the landowner or biomass facility may designate and contract the harvest and freight of the material.

Important contract provisions for biomass supply contracts with large landowners include considerations related to product pricing over time, biomass material origin and a few others. Aside from these particular provisions, the general discussion on contract components in Section 2 applies to this type of agreement.

Compensation. A constant market price for any product over the course of five to 20 years is unlikely, and landowners will want to capture the fluctuations in the marketplace. The specification of a landowner contract supplying a biomass facility may be as diverse as standing timber to be harvested by biomass facility crews or a third party, roundwood as for a pellet facility, or fully processed 'boiler-ready' material. In the case of standing timber purchased under a long term landowner contract, the price paid by the facility is effectively the stumpage price of the material, and this can be adjusted over the course of the contract to stumpage price reporting as discussed in Section 2.

In the case of delivered roundwood, pricing would include the stumpage paid for the timber, timber harvest cost, and freight to the facility. In this case, the contract could either partition the delivered price into components such as stumpage, diesel fuel, or other costs associated with production and transport. Alternatively, the contract could index delivered roundwood pricing to the level seen in price reporting services, which inherently reflect all costs of procuring, harvesting, and trucking wood.

If the contract specifies fully processed biomass, a similar strategy can be employed as is used for delivered roundwood. In the case of processed biomass, however, the price reporting services have more limited data on pricing of residual or otherwise fully processed fuelwood because the market for this material is much smaller than for delivered roundwood. If reliable price reporting is not available for the biomass facility's supply shed, the contract may index individual

components of the delivered price, such as freight, or the 'cut and load' rate that reflects logging costs.

In any of the above cases it may prove advantageous to establish a collar on prices. A collar sets a floor and ceiling on the delivered price itself or on any individual component of the delivered price. For example, any of the above specifications could index the stumpage price component to a reporting service, subject to a maximum and minimum price paid to the landowner. This has the effect of protecting the facility in the event of dramatic upward swings in stumpage prices, as well as guarding the interest of the landowner in the opposite case of very low stumpage prices. The same logic can be applied to the delivered price if that is the specification of the contract.

Case Study: Large landowner contract

A large landowner on the Gulf coast recently executed a seven year pulpwood supply agreement with a nearby mill for a total volume over the contract term of 3.9 million tons. The new agreement replaced a 12 year contract that was set to expire. Under the terms of the supply agreement, the pulp mill is liable for monetary damages for mill closures due to economic reasons for a one year period, providing a measure of protection for the landowner in light of several recent Southeast pulp mill closures in recent years. The new contract reportedly adjusted the pricing mechanism for the product, and removed some restrictions included in the previous agreement that limited the landowner's ability to sell some of its landholdings. This provision is of particular importance to this landowner as much of the acreage is in coastal areas and land sales in recent years have totaled well over 100,000 acres.

The volume contemplated in the supply agreement is substantial from the perspective of both parties. The average annual deliveries under the contract represent nearly one-fourth of the pulp mill's annual demand, a significant fraction from a single supplier. The average annual volume commitment represents 2.5% of the landowner's reported standing timber inventory on timberlands exceeding a half million acres. Not surprisingly, the revenue generated by the supply contract is a large fraction of timber income for the landowner. Under the final years of the expired supply agreement, revenue generated by the contract sales made up 54-57% of all timber product sales, including open market sales.

Delivery schedule. The biomass facility may wish to include a provision that allows it to defer delivery of material for a period of time. While this type of provision may be difficult or impossible to implement where logging residues make up much or all of the contract quantity (since residue generation depends on other logging activity), in the case of suppliers of roundwood or whole tree products, it may be an option. Deferment provides the facility the ability to put deliveries from the landowner contract on hold while it takes advantage of favorable biomass purchasing opportunities presented by events such as large storms or wildfires. Such a provision also insulates the buyer from unanticipated facility shutdowns, if this consideration is not accounted for elsewhere in the contract. While probably not ideal from the landowner's perspective, deferred quantities continue to accumulate volume as uncut standing trees, and as a result, do not necessarily need an alternative outlet. For providing this option, the

landowner may demand some sort of compensation in return for the disruption to its revenue stream or the idling of logging crews. This is justified as long as the opportunity biomass is of low enough cost.

Biomass material origin. This provision speaks to the individual properties where the biomass is harvested, and precision, with respect to biomass origin, is important to both the landowner and biomass facility. This may be incorporated into the biomass specification provision, or may be treated separately for clarity. From the facility's perspective, delivered biomass pricing will always be partly determined by the distance the material is hauled to the facility, and as a result, controlling freight distance aids in controlling biomass cost. This is true regardless of whether the contract is structured to compensate the landowner simply for stumpage, roundwood, or fully processed biomass, since the supply chain must inevitably extend from the facility to the contracted timber, no matter who is responsible for transporting the material. Large landowners will typically have holdings across a range of distances to the facility, and to provide a measure of control over biomass pricing, the contract should specify the freight distance that the facility is willing to pay for the delivered quantity of biomass. To do so, the facility may specify a fixed freight rate that would represent an average haul for the landowner, or partition the overall quantity into distance 'bins,' such as 50% from 50 miles or less and no more than 10% from greater than 70 miles.

A supply contract may give the landowner the option to source material from outside its timberlands. Since most large landowners anticipate the sale of some of their timberlands, this allows them to pursue that opportunity without sacrificing their ability to perform on the supply contract. Depending on market conditions in the supply area and the contract's pricing structure, some landowners may also wish to maintain the option to arbitrage low-cost biomass purchased on the open market. If the quantity contemplated in the landowner contract is a large enough share of the facility's biomass demand such that the landowner is effectively bidding against the facility and capturing significant volumes of lower-cost biomass within the supply shed, this provision may interfere with the facility's procurement strategy by forcing the facility or other biomass suppliers to tap higher priced biomass. This effectively elevates the overall pricing. As a result, such a provision should be subject to careful consideration.

Advantages and disadvantages to the biomass facility and landowner

Biomass facility.

Under a large landowner contract, the managers of a biomass facility know the type and location of the biomass being sourced. The facility is insulated from yield risk or risk of loss of the timber crop, as this is under the purview of the landowner. A further advantage of the landowner contract is that the agreement can be structured to enable the facility to 'throttle down' the volume of material when necessary. From the perspective of the biomass facility, much of the

appeal of contracting with large landowners is that the contract is executed with a creditworthy counterparty. Such security can, however, translate to relatively costly delivered pricing for biomass material.

Landowner.
Biomass supply contracts are attractive to large landowners inasmuch as they provide a stable and steady off-take of timber product to a known buyer, resulting in some income stability. Landowners benefit from protection against market declines, but may not fully benefit from market upswings. Landowners do experience yield and catastrophic loss risk, just as they do with all other timber products. However, in the case of biomass supply agreements, their ability to salvage and market damaged timber may be greatly enhanced. If the biomass targeted for delivery by the landowner consists of logging residue, the landowner has created a modest revenue source, while simultaneously reducing the cost of site preparation for plantation reestablishment.

4. Contracts with Wood Dealers

Description, parties, and provisions

A few different profiles fit the description of a wood dealer. A wood dealer may be a supply chain actor that has supply quotas with a number of different wood consuming mills in a region, maintaining off-take relationships with a few to several logging crews in the area. Alternatively, a dealer may simply be a logger who directly markets wood products to consuming mills. In either case, while some wood dealers may have sufficient assets to back a supply commitment, more commonly others will not have a balance sheet that makes a convincing case of their creditworthiness to most financing entities. In the common case where the dealer is not considered "bankable," a performance bond may provide an avenue to establishing a supply agreement.

Dealer contracts are generally straightforward, and offer much flexibility with respect to term, delivered volume, and material type provisions.

Term. Often the minimum term of interest to a supplier is a sufficient period of time to pay off the financing of any new pieces of equipment purchased to satisfy the biomass supply contract. Contract terms are thus at least five years in length, and most contracts can be extended on an annual basis upon completion of the initial term.

Quantity. While most facilities will, at some point, encounter a wood dealer seeking to supply all or a large share of the biomass supply, ultimately most dealer contracts are of medium scale.

The scale of a dealer contract is in large part a function of their current configuration. That is, if the supplier is interested in providing residual material, the quantity he or she can reasonably supply with their current operation reflects a given fraction of the volume of roundwood products they currently produce or the type and acreage of timber they harvest on an annual basis. A logger acting as a dealer who operates only a single crew, for example, is very limited in the volume of logging residue he can provide, because most timber stands in the Southeast yield only modest volumes of residual material.

Contracts with suppliers not constrained by limited residual volumes may have their contract quantity keyed to the size of the equipment they intend to deploy. This is particularly the case when the existing local logging capacity does not include in-woods chippers or associated equipment such as chip vans. Many suppliers may be unwilling to commit to the purchase of equipment without an off-take agreement, in which case the supply contract may need to be of sufficient scale that it accounts for all the output of the newly purchased machine. The largest whole tree chippers currently on the market have a purchase price approaching a half million dollars, and will produce more than 100,000 green tons of chips on an annual basis.

Delivery schedule. Dealers do not have the ability to "store on the stump," as do landowners executing non-residual contracts. That is, all the biomass they have purchased needs to be processed and delivered within a certain period of time. Furthermore, idling harvesting crews hinders the logger's ability to make loan and personnel payments, and can jeopardize the operation in a relatively short period of time. As a result, dealers have less flexibility to adjust their delivery schedule and may require some provision to protect them from such exposure.

Compensation. Dealers are sensitive to movements in both stumpage and diesel prices. This is because dealers must purchase biomass on the marketplace, and as a result must compete with other bidders for material (versus a landowner who already owns the timber). Because diesel makes up a significant portion of production costs, rapid and wide swings in diesel prices can result in large losses in a short period for dealers. Adjustment mechanisms for both of these cost components are relatively easily incorporated into supply contracts.

Material type. Because the type of biomass being captured influences equipment and production costs of the delivered biomass, the contract should outline the materials being supplied - small diameter roundwood, residual material or processed whole trees, or a mix of materials. Defining the material type also assists the facility in understanding the level of demand pressure that is being placed on the timberland resource in the region.

Advantages and disadvantages to biomass facility and wood dealer

Biomass facility.

The principle advantage of a wood dealer contract to a biomass facility is that it is much simpler and more accessible to the facility than most other types of contracts. The day-to-day operation requires sufficient output to keep its personnel and equipment deployed, and a consistent market aids in this effort. Not all landowners in the Southeast are large landowners, and biomass facilities are limited in their ability to engage the mass of small and medium size timberland owners. Dealer contracts afford the facility access to these timberlands as dealers are accustomed to maintaining the network of contacts and expertise to bid on and harvest these types of tracts.

Case study: Dealer contracts

A state-owned bioenergy facility currently under construction entered into an agreement with a wood dealer for the facility's entire woody biomass demand. The supplier will provide biomass from several sources, including primary and secondary mill residues, forest residues, and other sources of wood waste for a six year term, with the potential for two years of extensions. The contract quantity is an annual minimum of 100,000 as-received tons, with a maximum up to 165,000 tons subject to annual notice by the buyer. Monthly contract deliveries are scheduled 15 days in advance, and can be adjusted up or down as much as 30% under the contract. The contract requires the dealer to maintain approximately one month's worth of biomass in predetermined storage yards at all times.

The contract established a base delivered price composed of diesel and non-diesel fractions, with the diesel fraction making up approximately one-fourth of the overall price. The non-diesel fraction is adjusted to CPI on a quarterly basis, while the diesel component is adjusted weekly according to EIA diesel price reporting. Delivered pricing is also a function of the monthly average moisture content, with the non-diesel component moving up or down from its base level in the 30-40% target range.

Of particular interest to the bioenergy facility were forest derived residues (FDR), defined as timber harvest residues, unacceptable growing stock and cull trees, trees removed during thinning operations. The facility will not accept any biomass material resulting from the conversion of forest land to agricultural uses, or some conversion of forest land to commercial development. The facility also established sustainability standards for FDR that included the following elements:

- Requirement for written forest management plan prepared by a professional forest for all land from which FDR is sourced
- Compliance with state woody biomass best management practices manual
- Presence of at least one member of harvesting team who has completed the state forest product association's professional timber harvester program
- Presentation of compliance documentation relating to above requirements prior to initiation of FDR harvest operations

Wood dealer.

While some dealers may opt to focus on biomass production, biomass supply contracts are appealing to many dealers because they represent a complementary activity to traditional timber product output. Biomass production may not be the supplier's largest source of revenue, but it may provide stability and other benefits as well. For example, in areas with well-developed biomass markets, the ability to bid on some timber sales is contingent

upon the bidder's utilization of a chipping crew during harvesting. This is because the landowner's cost of site preparation for reforestation is reduced when the logging crew processes and removes residual material. The dealer may thus gain access or a comparative advantage over other potential timber sale buyers.

The downside of dealer contracts is that at the time of execution, the seller does not know exactly what material will be supplied or from what timberland the biomass will originate. This has often generated concerns from facilities and financing entities unfamiliar with the region's wood markets, compounding concerns about the supplier's creditworthiness discussed earlier. These types of contracts can be functional relationships, however, so long as the project can demonstrate abundant timberland resources and a well established harvesting and transportation infrastructure. Whether or not a dealer has the assets to backstop a supply commitment, many loggers and dealers in the Southeast are long-time family businesses. It is not uncommon to find operators with 50 or more years of performance history.

5. Lease Contracts

Description, parties, and provisions

Timberland lease agreements can be executed between a landowner and a biomass consuming facility. Leases afford the buyer access to timber located on a specified area during a specified term, while the landowner retains ownership of the land and may retain all or some use rights, such as hunting or recreation. Lease contracts in the region have historically tended towards long to very long duration. Some land lease agreements in the region were developed with terms exceeding 50 years. For biomass production, in which shorter rotations are sufficient to produce a crop, a shorter term lease may be preferable and acceptable.

Under a timberland lease, the lessee, or biomass buyer, has historically taken an active role in stand establishment and management. Land lease agreements may be more appropriate in situations where landowners have smaller holdings, when landowners may not be familiar with management or yield of a given tree crop, or when landowners are not in a position to make substantial investments in site preparation and stand establishment. An example of such a situation is the use of short rotation woody crops that are demanding in terms of cost and the technical aspects of site preparation and early rotation management. Landowners may be reluctant to commit to a crop whose production cost, yield, and risk of loss is unknown to them, while a biomass consuming facility may be in a much better position to evaluate these variables and thus take charge of production when use of the land asset is available. However, situations may exist in which landowners with understanding of advanced silvicultural practices could

prefer a joint agreement with the biomass facility where landowner compensation is partly based on yield.

Due to the long duration and partial transfer of rights and responsibilities inherent in timberland lease contracts, provisions common to other contracts are supplemented by some unique items.

Rights retained by the landowner. Nontimber values can generate important revenue streams for landowners and revenues generated early in the rotation or continuously throughout the rotation fundamentally change the economics of forestry production. This is the case when the landowner is responsible for paying annual property taxes. As a result, most landowners are not inclined to cede the right to execute hunting leases on their acreage. Some landowners may wish to harvest pine straw, another nontimber product that can generate attractive revenues and is harvested during a rotation's first decade. Since the product of interest to the buyer is the standing timber, use rights retained by the landowner do not typically present an obstacle to executing a lease contract. The exception to the division of rights described above occurs when ingress of outside parties is considered to increase exposure to additional liabilities or risks. In such a case, it may be best for the lessee to control all access rights, and possibly sublease them with increased control.

Responsibility for tract management. Many types of silvicultural and land management operations need to be conducted over the course of a lease contract, and the responsibility for carrying out the activities must be specified. Everything from maintaining access roads and fire lines to fertilization and competition control has a cost, and when not correctly conducted can put the standing timber at risk of loss to fire or infestation. Timber harvests can be damaging to natural features, infrastructure, or neighboring areas if not conducted in an appropriate manner, and as a result are rightly a central concern to the landowner. Tract residual condition is also important to landowners, as discussed below.

Because the buyer has an interest in both high yield and loss avoidance, the buyer often assumes the responsibility for and cost of management activities. This is particularly the case when the buyer wishes to establish a species or production system for which landowners lack experience. For their part, landowners may require approval of the management and harvest contract crews who will be operating on their land. Compliance with silviculture Best Management Practices is also likely to be written into the contract, and the landowner may indicate particular restrictions on some activities.

Compensation. Compensation structure is in large part a function of the use rights and management responsibilities of the contract parties, and as a result can take on a number of forms. Land lease contracts in the region where the buyer has responsibility for establishment and management costs typically include an annual lease payment to the landowner, and

sometimes an additional yield-based payment at harvest. Generally speaking, the more responsibility the buyer assumes for timber stand establishment and management, the less the landowner is compensated for timber yield upon harvest, to the point where the landowner may receive no payment at harvest.

Term. While the duration of land leases has historically been on the order of a few to several decades, shorter-term leases may now have increasing appeal. This is because advances in silvicultural practices have shortened southern pine rotation ages, and because tree crops of interest to biomass consuming facilities may be short-term woody crops whose productive rotation age may be 15 years or less. Continuing genetic improvement in tree crops may provide additional incentive to replace stands in order to obtain a crop with more attractive attributes that may further shorten rotations, if even by a single or few years. Progressive lessees will consider a variable length lease, in which they retain the ability to terminate within a fixed age range. For instance, a lessee enters into a base 25 year lease, but retains the right to terminate as early as age 20 or to extend the term to 30 years. This flexibility allows the lessee to adjust to market volatility or attractive feedstock sourcing opportunities. In some instances, flexibility may be a significant concern and perceived risk to the landowner, in which case a higher lease rate may be negotiated.

Quantity. Because lease agreements are area-based, the contract volume depends on the productivity of the underlying land and the management practices brought to bear on the crop. A biomass consuming facility entering into a lease contract would have knowledge of biomass yield levels and could anticipate with varying degrees of certainty, the volume generated by a lease contract.

Biomass specification. Unless the buyer has entered into a parallel or complementary harvest and process agreement with the landowner, the specification of the biomass product is likely to be the standing timber.

Residual condition. Specifications for the residual condition of the lease can vary greatly. Some landowners might prefer that the property be left in a clean, cutover condition at the conclusion of the lease so that they may best regenerate with whatever species they prefer. Other landowners might require that a certain number of leave trees of reasonable size and condition with cone-bearing crowns be left to serve as seed trees. For example, a requirement could be that a minimum of 15 pines per acre be left which have evidence of cone production and are 12” or greater in diameter at breast height. Other landowners might prefer to have advanced regeneration of various age structures in place at the end of the lease.

For a biomass lease with a short to medium lease term matched to a single rotation or a series of subsequent coppice rotations, a designated residual clean-cut condition might be the most realistic requirement. Under this scenario, the landowner wishes to optimize productivity going forward, while the leaseholder wants to replant the stand as quickly and cheaply as possible. As a result, the landowner's best interests may be served by assuming responsibility for the replanting effort upon expiration of the lease, as the type and quality of the effort will have long lasting effects on productivity.

Catastrophic events. Lease agreements should contemplate situations in which external events may result in the destruction or salvage harvest of timber prior to the expiration of the full contract term. For instance, if fire damages a loblolly pine tract in year 15 of a 25 year lease, and 95% of the 1,000 acre lease area is totally damaged, the contract should specify whether the lessee is able to terminate the contract at that point rather than requiring lease payments for the remainder of the term. Under the same example, landowner might not want to be encumbered with the remaining undamaged 50 acres and thus may wish to terminate the lease. The contract could then contemplate termination if less than some percentage, say 20%, of the lease is active.

Case Study: Timberland lease contract

A pulp mill in the Gulf South wished to ensure a steady flow of hardwood pulpwood across the entire year, a task made difficult at times because much of the region's hardwood volume occurs in low-lying tracts that are difficult to harvest in wet weather conditions. The mill initiated a program to establish eucalyptus to generate a source of hardwood fiber from upland acreage accessible in all conditions. While eucalyptus is a genus with several highly productive species and hybrids that is well-known elsewhere, it has not been widely established in the Southeast US due to its cold sensitivity. Ongoing species trials and plant breeding efforts are identifying cold tolerant varietals, and the genus appears to have significant potential within the region.

Nevertheless, landowners in the region are unfamiliar with eucalyptus production, and know little or nothing about yields or risks associated with insect pests or disease. Furthermore, correct silvicultural management at establishment and during the first few years of the stand are critical to a successful plantation.

In order to overcome these obstacles, the mill began to identify interested landowners in order to establish land lease contracts within its supply area. The lease contracts contemplated a minimum tract area of 50 acres, and the mill provided seedlings and all site preparation and silvicultural management for the duration of the lease, which is in turn determined by the length of the eucalyptus rotation, including coppice crops. Compensation details have not been made public, but the lease payments are likely tied to the mill's target for delivered fiber pricing. As a result lease payments are probably higher for tracts located closer to the mill and higher for tracts on more productive sites requiring fewer inputs to produce a given unit of fiber. To date, the land lease initiative has reportedly brought between 3,000 and 5,000 acres into eucalyptus production.

Advantages and disadvantages to biomass facility and landowner

Biomass facility.
With a lease contract, a biomass buyer secures access to a volume of raw material for a known period of time and from a known location without having to commit the economic resources required to purchase land. In the case of a biomass consuming facility wishing to utilize dedicated woody feedstock crops, land lease contracts may be the only practical way to bring land into production for their consumption.

Because lease contracts span a long period of time, and payment to the landowner for the fiber volume itself is often not directly tied to timing of harvest activity, lease contracts provide the buyer with the ability to "store on the stump." This allows the biomass facility to take advantage of the fact that tree crops continue to accumulate volume when they go uncut. This insulates the buyer from being forced to receive material or pay penalties during periods of unanticipated plant shutdowns.

Lease contracts will generally expose the buyer to both yield risk on the biomass crop or timber stand, as well as risk of loss due to pathogens or storms. To a certain degree, both yield and loss risk can be mitigated by good timber management practices and to a certain extent; biomass users are more flexible in their ability to utilize damaged timber than are other traditional forest products users.

Landowner.
Timberland leases are advantageous from the seller's perspective because they can reduce the capital required to produce a fiber crop, reduce the risk associated with producing a crop, and can ensure a stable revenue stream from their timberland.

6. Timber Deeds

Description, parties, and provisions

Like lease agreements, timber deeds can be executed between a landowner and a biomass consuming facility or other actor that markets wood products to various off-take markets. As with leases, the buyer gains access to timber located on a specified area during a specified term, while the landowner retains ownership of the land and all or some use rights. Unlike a lease agreement, the contracted wood has already been established, thus liberating the deed holder from any site preparation or planting decisions or responsibilities. Because the timber has already been established, the species composition and silviculture of a timber deed will likely be that of

the prevailing industry rather than an introduction of a novel species to the area, as can be the case with a lease agreement.

Timber deeds lend themselves to situations where timberland has access to a diverse selection of forest product off-take markets, but can reasonably be executed with the intent of generating a single product, such as biomass. Timber deeds contemplate land with established timber crops, often of varying age classes or species composition where multiple roundwood products in addition to biomass can be generated from the deeded acreage. For this reason, the buyer of a timber deed may be a forest products company with more than one type of mill in a region (e.g., a both a pulp and plywood mill), or may be a TIMO that has both the ability to manage the timberland as well as harvest and market the products generated by the deed. While a facility consuming biomass may not find a timber deed the most attractive opportunity for sourcing its biomass, a landowner-TIMO timber deed may in turn enable the establishment of an off-take agreement with the TIMO, in what would amount to a dealer type contract described above.

Another possibility for multiproduct timber deeds is that the biomass facility enters into a joint marketing agreement for non-biomass products with the landowner. A biomass facility may have limited ability to market conventional roundwood products, while large landowners often have longstanding relationships with area mills, which can work to the advantage of the deed holder. Under such a structure, the landowner could utilize its existing marketing channels for chip-and-saw or sawtimber logs, for example, and receive a percentage of the revenue generated by these higher value products. If the appropriate incentives to the landowner are in place, this could be beneficial to both landowner and biomass facility. For example, the landowner's marketing payment could be tied to the price received, relative to the overall market pricing, helping ensure that the highest value is being obtained for non-biomass products.

Many of the provisions in timber deed contracts are similar to those discussed in the context of timberland leases.

Rights retained by the landowner. As with timberland leases, landowners will likely wish to retain many or all use rights associated with the timber deed acreage.

Responsibility for tract management. Deeds are typically executed on acreage with existing timber, and as such, tract management activities will not include site preparation or stand establishment. Everything from maintaining access roads and fire lines to fertilization and competition control has a cost, and when not correctly conducted can put the standing timber at risk of loss to fire or infestation. Timber harvests can be damaging to natural features, infrastructure, or neighboring areas if not conducted in an appropriate manner, and as a result, are rightly a central concern to the landowner.

For their part, landowners may require approval of the management and harvest contract crews who will be operating on their land. Compliance with silviculture Best Management Practices is also likely to be written into the contract, and the landowner may indicate particular restrictions on some activities.

Compensation. Timber deeds usually include an up-front lump-sum payment for the current standing timber and the expected volume increment produced on the acreage over the term of the contract, but may also compensate landowners over an extended period.

Term. The duration of a timber deed is likely to be similar to the shorter duration land lease agreements, generally on the order of 10-25 years. As with leases, some flexibility may be built into the agreement.

Quantity. Deed agreements are also area-based; the contract volume depends on the productivity of the underlying land and the management practices brought to bear on the crop. A biomass consuming facility entering into a timber deed would have an expectation of yield for, and as a result can anticipate with varying degrees of certainty, the volume generated by a given deed.

Biomass specification. Unless the buyer has entered into a parallel or complementary harvest and process agreement with the landowner, the specification of the biomass product is likely to be the standing timber.

Residual condition. Specifications for the residual condition of the deed can vary greatly. Some landowners might prefer that the property be left in a clean, cutover condition at the conclusion of the deed so that they may best regenerate with whatever species they prefer. Other landowners might require that a certain number of leave trees of certain size, condition, and showing evidence of cone production be left on each acre to serve as seed trees. Other landowners might prefer to have advanced regeneration of various age structures in place at the end of the deed. As with leases when the residual condition is a stand after final harvest, the landowner's best interests may be served by their assuming direction and oversight of the replanting effort upon expiration of the lease, as the type and quality of the effort will have long lasting effects on productivity.

Catastrophic events. Deed or lease agreements should contemplate situations where external events may result in the destruction or salvage harvest of timber prior to the expiration of the full contract term in similar fashion to that discussed for lease contracts.

Advantages and disadvantages to biomass facility and landowner

Biomass facility.

Timber deeds allow a biomass buyer to secure access to a volume of raw material for a known period of time and from a known location, without having to commit the economic resources required to purchase land. Since the timber crop has already been established, the interval between contract execution and biomass harvest may be less than with a timberland lease.

As with timberland leases, timber deeds provide the buyer with the ability to "store on the stump." This allows the biomass facility to take advantage of the fact that tree crops continue to accumulate volume when they go uncut. This insulates the buyer from being forced to receive material or pay penalties during periods of unanticipated plant shutdowns. In addition, the biomass facility may wish to take advantage of occasionally available irregular buying opportunities. For example, while prices for traditional forest products can experience severe price spikes during periods of wet weather, they likewise can reach sufficiently low levels at other times of the year. In these instances, the biomass facility may wish to purchase spot market wood, reserving the lease contract volume for harvest at times of higher market prices.

Case Study: Timber deed

A large timberland owner in the Southeast US recently entered into a long-term timber deed agreement with a major TIMO. The timber deed affords the purchaser rights to the timber resource while the landowner retains ownership of the underlying land. The deed contemplates 20 years of harvest rights to timber on approximately 41,000 acres of forestland, primarily pine plantations, distributed across two neighboring counties. The reported value of the deed is nearly $56 million, paid when the agreement was executed. The landowner is responsible for payment of property taxes for the duration of the deed.

Timber stand ages for the deeded tracts range from 15 to 30 years, and once final harvests are conducted all use rights of the land revert to the landowner. During the period of the deed, the landowner retains hunt club and recreation revenues for affected acreage. The purchaser is required to conduct all harvest, fertilization, and other silvicultural activities in accordance with the state's silviculture BMPs. The purchaser assumes all risk of loss (e.g., fire, storm, or pathogens) associated with the timber stands. The landowner is responsible for replanting tracts upon final harvest.

Because the landowner has ongoing fiber supply agreement commitments with area mills, the purchaser is required to offer to the landowner all roundwood volume resulting from thinnings, or partial harvest, from the affected acres. The landowner is obliged to purchase at least 85% of the volume resulting from thinnings, but the purchaser has no obligation to offer nor is the landowner obliged to purchase any volume from final harvest activities.

The sale of the timber deed allowed the landowner to accelerate the monetization of part of their standing timber assets, while retaining all the other long-term options ranging from ongoing fiber production to real estate development. It furthermore maintained a modest revenue stream from hunting leases on the property, which almost surely meet or exceed the cost of their property tax obligations on the acreage.

Timber deeds may expose the buyer more than the seller to yield risk on the biomass crop or timber stand, and risk of loss due to pathogens or storms. To a certain degree, both yield and loss risk can be mitigated by good timber management practices. To some degree, biomass users are more flexible in their ability to utilize damaged timber than are other traditional forest products users. Finally, since timber deeds typically require an up-front payment, they tie up potentially significant quantities of funds that could be used for other purposes.

Landowner.
Timber deeds are advantageous from the seller's perspective because they can reduce the capital required to produce a biomass crop, potentially reduce the risk associated with producing a crop, and can ensure a stable revenue stream from their timberland. If a timber deed that pays the landowner up front is put in place, landowners are also able to monetize the value of their standing timber sooner than they would otherwise.

7. Managing Risk and Uncertainty with Supply Contracts

This report has identified a number of risks and uncertainties associated with ensuring a stable and sustainable biomass supply for individual biomass consuming facilities.

Table 1 below summarizes the principal types of risk and uncertainty, their origin, and the main strategies used in responding to those risks and uncertainties. While biomass facilities and biomass producers alike are exposed to some uncertainty and risk over which they have little or no control, other risks can be managed to some degree with biomass supply contracts.

A good example of the former is volatility in fossil fuel prices generally, and diesel fuel specifically, which illustrates how an understanding of the biomass supply chain is necessary to managing uncertainty. The supply chain's dependence on diesel fuel exposes it to rapid swings in price, and the facility needs to be aware of the impacts of such swings. It is in neither party's interest for a supplier to fail and default on a contract as a result of fuel price fluctuations. Procurement at the biomass facility is ultimately compromised by supplier failure because the facility must find a replacement, potentially without much time to negotiate favorable terms, for the facility.

Alternatively, great security in biomass supply quantities can be had via either large landowner contracts or timberland leases, for example. The risks and uncertainties confronted by large landowners under long term contract do translate into a higher biomass price, however. While secure and presumably executed with a creditworthy counterparty, the biomass price contained in a contract of this type could be as high as the price resulting from increased competition by a future facility sited within the supply shed. If that competing facility is never built, the biomass

facility has created a secure supply, but has damaged its overall economics by paying a premium for material when it was unnecessary.

None of this is to say that a long-term biomass supply contract is a bad idea, but rather parties must put into perspective the trade-offs between biomass supply security and biomass price. In the end, the supply issues confronting each facility are different, and clearly biomass supply contracts can never substitute for good judgment in the selection of facility suppliers, or the identification of underutilized resources in the supply shed.

Table 1. Summary of risk and uncertainty types, sources, and potential management measures.

Risk / uncertainty type	Main sources	Potential for mitigation or management	Management measures
Production cost uncertainty	▪ Diesel fuel volatility ▪ Inflation	Low to moderate	▪ Build fuel cost 'pass through' provisions in biomass facility offtake agreements ▪ Petroleum/diesel fuel hedging
External demand uncertainty	▪ Demand (domestic and international) for renewable energy ▪ Demand for building products, such as oriented strand board, made from small diameter timber	Low to moderate	▪ Long-term supply agreements to secure needed quantities ▪ Land leases to generate dedicated biomass exclusively for facility ▪ Diversification of biomass material types
Biomass crop risk	▪ Catastrophic events (fire, storm, pathogens) ▪ Yield underperformance	Low (storms) to high (fire, yield)	▪ Good silvicultural management practices ▪ Timberland insurance ▪ Diversification of suppliers, material types, and geographic sources
Counterparty risk	▪ Exposure to production cost or other market volatility	Moderate to high	▪ Selection of stable and reliable suppliers ▪ Sound contract construction (to avoid conditions leading to supplier default)
Regulatory uncertainty	▪ Dynamic nature of natural resource and renewable energy policy	Low to moderate	▪ Abide existing regulations ▪ Involvement in industry groups

8. Biomass Supply Contracts and the Georgia Timber Industry

The potential for long-term biomass supply contracts is considered below. Inasmuch as the execution of such supply agreements may enable the expansion of Georgia's biomass industry generally, it's worth considering what impacts this activity may have on the timber supply chain and the state's forest resources.

Supply chain impacts

The impacts of long-term supply agreements are not new to the market and are basically similar to the effects of large landholdings. Land available for the production of all commodities that a global society needs is limited. Land tied up by one industry sector or any one player in a regional market may affect the supply of forest products available to other wood users, assuming the commodity is actually limited in availability. This potential need for supply risk limitation is the reason that conventional industrial and integrated forestry companies historically maintained a large land base to support their mill operations. While also helping to ensure supply volumes and decrease supply risk, improved economies of scale helped to develop preferred pricing for silvicultural activities. If a biomass facility is able to procure a large volume of needed supply from one or two producers, it may be able to use this as a base and procure the additional wood needed at a reduced price. Conversely, the facility may have to supply the mill with higher priced forest biomass when wet weather sets in. As noted, all of these effects are not new and the situation is understood within the industry.

A typical planted pine rotation at present involves one or two thinnings for smaller diameter material such as pulpwood, around age 15 and 20, with a final harvest of the stand at age 25 to 30. What may be novel to the prevailing timber market would be if the biomass markets were able to procure wood at a more juvenile stage as compared to the harvest ages of competing markets such as pulpwood or small sawtimber. For example, a biomass facility purchases loblolly pine for chips when it reaches 5-8 years of age and a pulp mill in the same wood basket defers purchase of loblolly pine to age 15. Assuming limited supply, without an adaptation in procurement strategy by the pulp mill, the biomass facility would not experience immediate direct competition for this segment of the biomass resource from the pulp mill and eventually the supply of 15+ year old wood available to the pulp mill might decrease. However, the pulp mill would not be without competitive remedy, as it could seek to develop long-term lease or timber deed agreement, purchase and hold land in fee-simple ownership, or seek to pre-purchase the timber by timber deed at ages 5-8 and hold the timber for growth until the desired age.

Another pathway that may develop is increased planting densities of conventional timber species such as slash and loblolly, so that a fraction of the timber can be removed at a younger age, transitioning to a stand that has undergone a thinning for biomass production, but retaining a tree

density similar to that typically employed to produce conventional roundwood products. Such a scenario may provide early rotation income to landowners while increasing the overall productivity of the supply shed's timberland. Such hybrid type systems are undergoing trials at present, and successful systems may ultimately include a mix of genotypes of a single species (versus the current standard of uniform genetics) or a mix of different species within a stand.

The situation described above may not differ significantly from the impact the pulpwood production market had on the forest resource when it was new. Prior to this development, standing forest wood products were primarily used for sawtimber and fuelwood. Emerging pulpwood markets could then use smaller diameter trees for pulping, potentially preventing a portion of the forest trees from reaching sawtimber size. Rather than running out of sawtimber, the need for both pulpwood and sawtimber products spurred purposeful growth of both products, focused research on improving productivity of both products, and created major improvements in sawing technology. The result is that we now have more forest volume standing than at that time, including a surplus of standing sawtimber.

Biomass industry development and Georgia's forest cover

Reforestation of harvested woodland sites in the woodshed is a key to sustainability and production of biomass. Except in the case of transition from a wooded area to another use, e.g., woodland to development or agriculture, reforestation of harvested stands in the wood shed will occur. The form of replanting, the productivity of that reforestation, and the diversity of the woodshed are at issue. Biomass sourcing should consider and balance existing reforestation options where possible. Options for regeneration include multiple methods of natural regeneration, and multiple levels of intensity of artificial regeneration. There is an important place for biomass harvesting in the management of both natural and artificial systems, and the biomass removed from both systems can contribute to the total needs of a biomass facility in a particular woodshed.

Forest stands utilizing natural regeneration may or may not offer decreased discounted cash flows, but usually offer less biomass volume production potential to a landowner or lessee. Artificial regeneration productivity gains over natural production are due to controlled density, controlled competition, focused resources, improved growth due to genetic improvement, and the over-all manageability due to the structure imposed. In the case of natural mixed pine-hardwood forests versus planted pine forests, yields with established loblolly pine plantations may now be as much as four times greater on a per acre basis. Other fast growing species such as cottonwood or eucalypts may produce even higher yields when established on appropriate sites.

Because of the potential gains in productivity by moving to an artificial regeneration based regime, some have expressed concerns that the existence of a biomass facility will result in

widespread clear cutting of the landscape and follow-up plantings of dedicated energy crops will decimate diversity in that woodshed. For this reason, some environmental groups work to limit the use of biomass from newly established plantations, or seek to limit the sourcing of biomass to residuals or waste. Doing so, however, may take important stewardship and ecosystem management tools off the table. Purpose grown plantations can decrease pressure on natural stands, while the presence of biomass markets empowers the financial accounting of the natural forest management system.

Past examples like the rise of the pulpwood industry have shown that private landowners, who now own more than 60% of the Southern forest, will not convert all their forests due to the lure of a low-value product, nor will all landowners choose artificial regeneration as their preferred reforestation method. Ownership objectives are diverse and multiple, even on any single property, and are not entirely focused on revenue generation from forest product production. Given a free market to drive forest management and investment decision making, landowners will invest in a mix of forest stand cover types to meet their multiple objectives. To allow expenses to be covered, they will include some purpose-grown crops for revenue, while special areas and cover types are protected.

While overall species diversity on the acres dedicated to intensive timber production may be lessened, it is this high production designation that allows for the compromise of society's needs to be met while special areas and habitats are set-aside or managed at lower intensities; thus, there is a place for purpose grown biomass. A large scale company in the South Carolina Coastal Plain region, Mead-Westvaco, demonstrated this well in the late 1990's and early 2000's where their intensive operations on 65% to 70% of their land allowed for the designation of protected and/or lower-intensity management strategy on the remainder of the land base. This voluntary stewardship example and its percentage allocations are similar to those mandated in some areas of South America. In Georgia specifically, high levels of voluntary compliance to Best Management Practices (over 94%) on the part of forest landowners is also a testimony to the stewardship and balance of our forest owners.

Regenerating Georgia's Forests

Natural regeneration. Biomass markets can and should play an important part in a natural regeneration system. In the case of natural regeneration for Southern yellow pine species, biomass harvesting can play an important role in quality seedbed preparation as well as needed density control after planting. The initial limitation for a naturally regenerated pine stand is the opportunity for either seeds in place or seed from residual seed trees to come into contact with mineral soil. Biomass harvested or material left by conventional harvesting systems can help prepare the seedbed.

The result of a successful natural regeneration system for Southern pines is more times than not an overstocked stand, and a common follow-up treatment is pre-commercial thinning, where stems above the desired tree density are felled to waste. This out-of-pocket cost can be substantial, often in the range of $100 to $200/acre, and is a deterrent to using natural regeneration. The presence of a biomass system can be of great benefit if it allows for the commercialization of the stems that need to be removed to avoid stand growth stagnation and promote the growth of the quality stems present.

Natural regeneration of hardwood systems in the Southeast US is similar in some ways to that of yellow pine. Exceptions include the desire to control species composition among multiple sprouting species with varying competition strategies, growth rates, and shade tolerances. Regenerating natural red and white oak species stands is a good example of how hardwood regeneration is similar to pine. Options for doing so include clearcutting with advanced regeneration in place, or two or three stage shelterwood cut systems. Simple clearcutting with no harvest planning may result in pioneer species such as sweetgum and yellow poplar taking over the site due to their stump-sprouting, heavy seedfall, and fast early growth strategies. Increasing the opportunity for competitive oak regeneration often requires planning for advanced regeneration and continued shading to control pioneer species growth and favor the development of the slower growing, but shade tolerant oaks. As with southern pine natural regeneration management, biomass harvesting under a two or three stage shelterwood system can be helpful in preparing the seedbed and removing an understory of merchantable and conventionally non-merchantable pioneer species, while the oak gets established and builds root reserves.

Natural regeneration practices for southern pine stands

Common natural regeneration options include seeds-in-place, seedtree, and shelterwood systems. A successful seeds-in-place system for pine will schedule a clear-cut harvest in a stand with adequate cone-bearing pine mature overstory being removed after annual pine seedfall and prior to spring germination. The seedfall timing differs some by pine species, but generally occurs in the fall between September and December. The fallen seeds placed naturally in the litter layer may be viable until late spring. A harvest during this period that removes the standing timber, including conventionally unmerchantable advanced regeneration that might shade out the seeds when they sprout, and disturbs the soil placing the seeds in place in contact with the mineral soil, would be positive for quality regeneration.

A seed-tree harvest system is one where all but a small number of mature seeding trees are left standing in a heavy cut, to seed in the tract. The seed trees are later removed, generally somewhere between age 2 and 5, after adequate regeneration of the preferred species is established. Shelterwood regeneration is similar to a seed-tree system, but a heavier overstory is left to ensure natural seeding success. Like a planned seed tree harvest, the shelterwood trees left for seeding are also removed in a later cut, after successful stocking is achieved.

After the oak regeneration is successfully established and allowed to occupy the site, it often goes through a long period of stem exclusion. In many woodsheds, this period of stem exclusion, in which self-thinning occurs due to mortality, is extended due to the lack of commercial markets for the biomass present. A biomass market can be very positive if it opens up commercial opportunities for managers to shorten this period and create opportunities to identify quality future sawtimber crop trees and free them to grow earlier.

Artificial regeneration. Artificial reforestation for forest biomass may consider the use of multiple conventional species or that of some yet to become considered conventional. In the Southern US, loblolly pine, *Pinus taeda*, is our most adaptable native species and can be planted on a wide range of sites of varying drainage and fertility in the Piedmont and Upper and Coastal Plain Regions. Slash pine, *Pinus elliottii*, is widely used in the Coastal Plain region and specifically on the spodic soil areas of the Georgia Flatwoods. Of the hardwood species options, sweetgum (*Liquidambar styraciflua*) is perhaps the most "plastic,"

Tree improvement in the Southeast U.S.

Since 1955, three tree improvement cooperatives in the South have worked on efforts to improve open-pollinated families of loblolly pine and some slash pine available to Southern forest landowners. These families and the known performance values provide the base for even more valuable control-mass pollinated (CMP) seedling production and varietal selections. Use of CMP and varietal planting stock has increased since 2000. 2011-2012 planting season estimates for loblolly CMP and varietal stock are 42.8 million and 10+ million respectively, making up 5 to 10% of the total loblolly seedlings sold for this planting season (McKeand 2011). Estimates of average biomass production improvement over natural seed by genetic level of improvement for loblolly pine seedlings are as follows: 2nd generation mix 17%, Best 2nd generation seedlings 25%, best 3rd generation 35%, control mass-pollinated 40%, and varietals 50% (Dougherty et al. 2010). At present, work is underway through the Forest Tree Improvement Cooperative at NC State University to screen existing loblolly pine genotypes for those that would offer preferred traits specifically for biomass production (McKeand 2011).

Production potential for loblolly biomass plantings in the Southeast US is perhaps best demonstrated by work completed by the Plantation Management Research Cooperative based at the University of Georgia Warnell School of Forestry. The cooperative's Culture x Density Study series work as summarized and published by Zhao et al. (2011) shows annual growth potential of 8 to 11 merchantable tons/acre-year over a range of densities from 300 to 1,500 stems/acre with intensive culture through age 12 in the Southeast Coastal Plain. These production levels were achieved with open-pollinated seedling and dated management. Current production levels could be higher with advanced genetic improvement options and today's silviculture.

Dougherty, et al. 2010. *Valuing Tomorrow's Loblolly Pine Plantations Today.* Forest Landowner Magazine. Atlanta, GA.

McKeand, S. 2011. Personal Communication. Forest Tree Improvement Cooperative, Raleigh, NC.

Zhao, et al. 2011. *Growth responses to planting density and management intensity in loblolly pine plantings in the southeastern USA Coastal Plain.* Annuals of Forest Science 68:625-635.

with wide adaptability to sites in the Piedmont and Coastal Plain regions, and growth rates that are similar to that of unimproved loblolly pine. Eastern cottonwood, *Populus deltoides*, is capable of very strong growth rates, but is very site specific in its needs for good drainage and high fertility. Other fast growing native Georgia hardwoods include sycamore (*Platanus occidentalis*) and yellow poplar (*Liriodendron tulipifera*).

Some eucalyptus species, which are not native to the US South but exhibit little or no potential for invasiveness[1,2], show potential for high productivity[3]. This is true on a moderately wide range of sites with proper or amended drainage through bedding as needed, detailed vegetation management, and attention to nutrition demands. The main limitation for eucalypt species for biomass has been the lack of frost tolerance. *Eucalyptus benthamii* and *E. amplifolia* have demonstrated fair tolerance to frost and are currently planted in pilot and early scale up plantings. These efforts are only appropriate for testing in the most Southern sections of Georgia at present. Work to identify additional frost tolerant eucalyptus species is ongoing through the Forest Productivity Cooperative and its Regionwide 24 Study series[4].

Given North America's history of exotic species introductions resulting in a number of unintended detrimental consequences, some private groups and governmental agencies have expressed concerns about the establishment and production of non-native species. The introduction of invasive species can result in widespread economic damages and endanger important components of Georgia's natural heritage. While Georgia has not formalized a strategy to address this concern, some states have taken action to limit such introductions. Neighboring Florida, for example, has a rule that requires that landowners apply for a permit for dedicated biomass plantings of exotic species that exceed two acres. Issuance of the permit requires inspection of the planting site by state personnel, the maintenance of buffers to prevent the potential for spread, and the posting of a bond to cover any unanticipated eradication costs.

Silvicultural management practices have a large impact on productivity and yield of all plantation species. The growth of the best genetically improved stock may be wasted without proper growth culture. Strong understanding of the needs and potential of our plantations and naturally grown stands has been demonstrated through several of the Southern forestry universities, cooperatives, and industrial and private efforts over the past 60 years. In the Southeast, more research dollars and efforts have been focused on loblolly pine than any other species, and the return on investment from these research efforts has been strong. Additional

[1] da Silva, Poggiani, Sebbenn, and Mori. 2011. Can *Eucalyptus* invade native forest fragments close to commercial stands? *Forest Ecology and Management*. 261: 2075-2080.
[2] See also ongoing invasiveness risk assessments conducted on several eucalypts by the University of Florida Institute of Food and Agricultural Sciences (http://plants.ifas.ufl.edu/assessment/).
[3] Dougherty and Wright. 2010. Financial evaluation of eucalypt bioenergy plantations in the SE United States. *Forest Landowner*.
[4] Fox, Rubilar, and Stape. 2011. *Research Summaries.* Forest Productivity Cooperative. North Carolina State University, Virginia Polytechnic Institute and State University, University of Concepción.

efforts to understand the growth and manufacturing of our forest biomass species will be beneficial to maximizing value, minimizing production cost, and protecting natural resources.

9. Glossary

Delivered price - the sum paid to a supplier for biomass received at the facility in the contractually specified form (e.g., roundwood, chips, etc.).

Green weight - or *as-received weight*, the mass of a volume of biomass as delivered, including dry matter content as well as water contained in the plant material.

Oven dry weight - or *bone dry weight*, the mass of a volume of biomass at 0% moisture content.

Roundwood - harvested trees that have undergone no processing aside from the removal of tops and limbs, and cut to a length suitable for trailering to an offtake facility.

Stumpage price - the price paid to a landowner for their timber, in the case of biomass usually expressed in a value of dollars per ton.

Timber dealer - an agent that identifies tracts of timber offered for sale who contracts to sell timber products to one or many offtake mills. Different actors can fulfill the function of a dealer, including loggers.

Timber REIT - *timber real estate investment trust*, firms that specialize in income producing timberland ownership and that are organized as real estate trusts under IRS rules, meaning that they distribute most of their taxable income to investors as dividends. Timber REITs may also own other assets such as sawmills.

TIMO - *timberland investment and management organization*, an entity that purchases and manages timber assets on behalf of clients, typically institutional investors or high net worth individuals.

10. Appendix

An example of a biomass supply agreement is attached below for illustrative purposes. The contract is an actual working document assembled by a large supplier for consideration by a bioenergy facility. The supplier in this case fulfils the functions of a timber dealer as discussed in the report above, although all material to be supplied under the contract is not forest-derived biomass.

While parts of the contract would likely need to be altered in order for it to be executed (for example, 6.2.b. regarding termination by the supplier), much of the language and structure of the document is generally representative of biomass supply agreements with timber dealers.

The inclusion of this contract is for illustrative purposes only, and no representation is made here as to its validity under Georgia law.

BIOMASS FUEL SUPPLY AGREEMENT

THIS BIOMASS FUEL SUPPLY AGREEMENT ("Agreement") is entered into on [redacted] (the "Effective Date"), by and between [redacted], a [redacted] corporation, serving as the biomass facility ("Facility") and [redacted], a [redacted] corporation, ("Supplier") referred to each individually as "Party" and collectively as "Parties."

WITNESSETH:

WHEREAS, Supplier in the course of its business acts as an agent for numerous Generators in managing the disposal of a variety of Biomass Fuels; and

WHEREAS, Supplier is charged with sourcing and contracting for acceptable Biomass Fuel to be delivered for combustion at Facility on behalf of Facility.

WHEREAS, Facility will operate a [redacted] MW biomass-fired electric generation facility (the "Project") located in [redacted], in [redacted] County, [redacted];

WHEREAS, Supplier desires to deliver to Facility and Facility desires to accept from Supplier, all permitted Biomass Fuel which may be managed by Supplier on behalf of the Generators, subject to the conditions set forth herein; and

WHEREAS, Supplier shall coordinate shipping the Biomass Fuel from the respective Generator's Facility to the Project, subject to the conditions set forth below;

NOW, THEREFORE, in consideration of the mutual promises and covenants contained in this Agreement, the Parties agree as follows:

SECTION 1. DEFINITIONS

1.1 Definitions. Capitalized terms in this Agreement shall have the meanings set forth in this Agreement.

1.2 Interpretation. Unless the context requires otherwise, in this Agreement:

(a) Words singular or plural in number shall be deemed to include the other and pronouns having a masculine or feminine gender shall be deemed to include the other.

(b) Any reference in this Agreement to any person shall include its permitted successors and assigns.

(c) Any reference in this Agreement to any Section, Exhibit or Schedule shall mean and refer to the Section contained in or the Exhibit or Schedule attached to this Agreement; and

(d) The words "include" and "including" shall mean to include, without limitation.

SECTION 2. DELIVERY AND ACCEPTANCE OF BIOMASS FUEL

2.1 Acceptance of Biomass Fuel. Facility is obligated to accept all Biomass fuel from Supplier that meets all of the following criteria (subject at all times to the quantity limitations set forth in Section 2.3):

(a) It shall be substantially in the form of hogged biomass fuel from land clearing activities; forest thinnings or harvesting; beetle kill or fire damaged trees; tops and slash; bark; residues from post, pole and fence manufacturing; sawdust; green chips; acceptable processed yard wastes; woody storm debris from natural disasters; and, peanut hulls etc. Under the terms of its State regulated permits, Facility cannot accept any treated wood wastes including but not necessarily limited to those containing creosote; copper chromated arsenate; or, pentachlorolphenol.

(b) It shall be substantially free of contaminants, including but not limited to dirt, rocks, metals, sand, municipal solid waste or other contaminants; and

(c) It shall have an average moisture content no greater than forty five (45%) percent.

2.2 Measurement in Tons. Biomass Fuel delivered to Facility shall be measured in tons;

2.3 Quantity of Biomass Fuel to be Delivered.

(a) During the term of this Agreement, Supplier agrees to deliver to Facility, and Facility agrees to accept, up to [redacted] tons of Biomass Fuel per year.

(b) The Parties shall work in good faith to adjust from time to time, the quantities of Biomass Fuel that Facility agrees to take, and that Supplier agrees to deliver, and to make any necessary adjustments in the volume of Biomass Fuel delivered due to seasonal variations of the availability of Biomass Fuel, Facility operations, and Supplier operations.

(c) Notwithstanding Sections 2.3(a) and (b), Supplier shall not deliver more than [redacted] tons of Biomass Fuel per month.

2.4 Schedule of Deliveries. All Biomass Fuel delivered under the terms of this Agreement shall be transported by one or more trucks (each a "Truck") on a schedule consistent with Biomass Fuel availability under Supplier's management. Supplier shall be responsible for coordinating the loading each and all Trucks with Biomass Fuel in a safe and reliable manner.

2.5 Disposal of Ash Resulting from the Combustion of Biomass Fuel. The disposal of ash shall be the sole responsibility of Facility, and shall be disposed of in accordance with all pertinent laws, rules, and regulations.

SECTION 3. INSPECTION AND WEIGHT CALCULATION

3.1 Visual Inspection.

(a) Prior to unloading Biomass Fuel from the truck, each shipment shall be visually inspected by one or more Facility representatives.

(b) Prior to unloading, a Facility representative shall have the right to reject such shipment if such representative determines that such shipment does not substantially conform with the definition of Biomass Fuel set forth herein, including but not limited to moisture content and contamination.

(c) At any time Supplier may, at its sole cost and expense, have any shipment tested to determine whether it meets the definition of Biomass Fuel. If such definition is met, Facility shall, without waiving any right herein other than the right of rejection, accept such shipment.

(d) Supplier shall bear all costs related to the return or subsequent disposal of rejected shipments which following testing, do not meet the definition of Biomass Fuel.

3.2 Weighing Procedure. Unless rejected, a shipment shall be weighed at Facility's weigh scale at the Project. The weight of each shipment shall be determined by taking the gross weight of each Truck less the net weight of the Truck immediately after discharge of the Biomass Fuel, and dividing such resulting weight by 2,000 to arrive at the tons of Biomass Fuel in each shipment. Such resulting tonnage amounts delivered shall be electronically confirmed and signed by both Facility personnel and the driver**.**

3.3 Inspection by Supplier. Facility's measurement results, scales, equipment and records relating to Biomass Fuel delivered hereunder shall be available for inspection and review by Supplier at the Project (or other location reasonably specified by Facility) upon reasonable notice.

SECTION 4. SHIPPING COSTS

4.1 Obligation for Payment of Shipping Costs. Supplier shall coordinate the supply of trucks as requested by Generator for shipping Biomass Fuel to the Project.

4.2 Delivered Fuel Costs. Facility shall pay Supplier a negotiated fee of up to [redacted] ($[redacted]) Dollars per ton for all acceptable Biomass Fuel delivered to the project over the term of this BIOMASS FUEL SUPPLY AGREEMENT.

SECTION 5. PAYMENTS TO SUPPLIER

5.1 Payment. All payments are due (30) thirty days from receipt of invoice.

5.2 Disputed Payments. The Parties shall attempt to resolve disputed payments informally. Unless resolved by mutual agreement of the Parties within ninety (90) days of the payment due date, any dispute regarding any amount due shall be resolved in accordance with Section 10.2.

5.3 Records. Supplier and [redacted] shall maintain, for a period of five years, all written and electronic information reflecting the amount of Biomass Fuel delivered along with shipping cost calculations and, upon 30 days' advance notice, shall have access to each of the other Parties' records during normal business hours for purposes of inspection, auditing and copying.

SECTION 6. TERM AND TERMINATION

6.1 Term. The term of this Agreement shall be for five (5) years from the Effective Date, unless terminated prior to such date in accordance with Sections 6.2, 7.5, or 9.1, or extended by mutual agreement of the Parties.

6.2 Termination.

(a) In the event that the Power Purchase Agreement between Facility and [redacted] is terminated, Facility shall have the right, but not the obligation, to terminate this Agreement by providing Supplier with written notice of its intent to terminate this Agreement; termination shall be effective thirty (30) days after such notice is received.

(b) In the event that the Supplier's costs of supplying the Biomass Fuel (including shipping costs) increase, thus making the costs of combusting Biomass Fuel at the Project uneconomic, the Supplier shall have the right, but not the obligation, to terminate this Agreement by providing Facility with written notice of its intent to terminate this Agreement; termination shall be effective thirty (30) days after such notice is received.

SECTION 7. FORCE MAJEURE

7.1 Excuse from Delivery and Acceptance Obligations. Supplier shall be excused from failure to deliver Biomass Fuel to Facility and Facility shall be excused for failure to accept deliveries from Supplier to the extent that in any period where performance is prevented by an event of force majeure, which is defined as unforeseeable causes beyond the reasonable control of and without the fault or negligence of the Party claiming force majeure including, but not limited to, fire, flood, extreme weather conditions, hurricanes, riot, civil commotion, war, strikes, lockouts, or other labor disputes, actions by federal, state, and municipal agencies and actions of legislative, judicial or regulatory agencies that conflict with the terms of this Agreement (each a "Force Majeure Event").

7.2 Notice of Force Majeure. The non-performing Party shall, within seventy-two (72) hours after the occurrence of a Force Majeure Event, or, in the case of a Force Majeure Event caused by legislative, judicial, or regulatory agency action, as soon as practicable, give the other Parties written notice describing the particulars of the occurrence. Suspension of performance shall be of no greater scope and of no longer duration than is required by the Force Majeure Event.

7.3 Best Efforts. In each instance of a Force Majeure Event, the Party claiming force majeure shall use best efforts to resume performance of its obligations under this Agreement as soon as the occurrence of force majeure is removed.

7.4 Renegotiation. In the event a Party is unable to perform due to legislative, judicial, or regulatory agency action, the Parties agree to renegotiate the terms and conditions of this Agreement in good faith so as to enable each Party to substantially perform its obligations under this Agreement. If, despite such negotiations, the Parties are unable to agree, the continuance of the Force Majeure Event shall continue to excuse performance as provided in this Agreement.

7.5 Termination for Force Majeure. In the event of major damage to key operations of either Party, after which that Party, in its own judgment, elects not to rebuild the damaged facility, such Party shall have the right, but not the obligation, to terminate this Agreement by providing written notice to the other Parties.

SECTION 8. INDEMNIFICATION AND INSURANCE

8.1 Indemnification. The Parties shall, to the extent permitted by law, each indemnify, hold harmless and defend the other from and against all costs, losses, claims for damages, liabilities and expenses, including but not limited to legal fees and court costs, arising out of the indemnifying Party's negligent acts or omissions or willful misconduct related to its performance under this Agreement, or an uncured default under this Agreement. In the event of concurrent negligence, each Party shall be responsible for its allocable share of fault, and shall indemnify the other Parties for its share of concurrent negligence.

8.2 Insurance. Throughout the Term of this Agreement, the Parties shall each separately maintain and, upon requested by the other Parties, shall provide a Certificate of Insurance, demonstrating that coverage has been obtained as outlined below:

(a) Worker's Compensation Insurance as required by [redacted] Statutes, Chapter [redacted];

(b) Automobile Liability Insurance covering all owned and hired vehicles used in connection with this Agreement in an amount not less than one million dollars combined single limit per occurrence for bodily injury and property damage; and

(c) General Liability ($1 million per occurrence (combined limit Property Damage and bodily Injury)).

SECTION 9. DEFAULT

9.1 Except where expressly stated herein, if a Party shall fail or neglect to perform or observe any of the terms or conditions in this Agreement on its part to be performed or observed, and such default shall continue for thirty (30) days or more after written notice of such failure or neglect shall be given by another Party, or if bankruptcy or receivership proceedings, voluntary or involuntary, shall be commenced against a Party, or if assignment of a Party's property shall be made for the benefit of creditors, then, in any such event, the either of the other Parties may, by written notice, terminate this Agreement. Termination for default shall be effective when such termination notice is received.

9.2 It is agreed that the remedies given are not exclusive and are without prejudice to any other remedy available, and that in addition, the Parties shall have all other remedies available at law or in equity. Any waiver by either Party of a breach of a provision of this Agreement shall be limited to such particular instance and shall not operate as a waiver of or be deemed to waive any future breaches of any of such provisions.

9.3 IN NO EVENT SHALL EITHER PARTY BE LIABLE OR RESPONSIBLE FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, HOWSOEVER IMPOSED.

SECTION 10. MISCELLANEOUS

10.1 Notice. Any notice required or permitted to be given under the provisions of this Agreement shall be given by registered or certified mail as follows:

If to Supplier, to: [redacted]

[redacted]

[redacted]

If to Facility, to: [redacted]

[redacted]

[redacted]

Unless a Party changes its address by giving notice to the other Parties as provided, notices shall be delivered to the Parties at the addresses set forth herein.

10.2 Venue. Any claim arising under or relating to this Agreement, or any breach hereof, shall be brought in [redacted] County, [redacted].

10.3 Independent Parties. No Party shall be considered an agent of the other Parties.

10.4 Subcontracts. No Party may subcontract any of its obligations under this Agreement (except for transportation), without the prior written consent of both of the other Parties, which consent shall not be unreasonably withheld, delayed or conditioned.

10.5 Assignment. Neither this Agreement nor any right or claim hereunder shall be assigned by any Party without the express written consent of the other Parties, which consent shall not be unreasonably withheld, delayed or conditioned.

10.6 Drafting Interpretations. Preparation of this Agreement has been a joint effort of the Parties and the resulting document shall not be construed against one of the Parties more than against the other.

10.7 Choice of Law. This Agreement and any dispute arising there from shall be governed and interpreted in accordance with the laws of the State of [redacted] as applied to contracts made within [redacted].

10.8 Entire Agreement. This Agreement sets forth the full and complete understanding of the Parties as of the date above stated and supersedes any and all agreements and representations made or dated prior to the date hereof. This Agreement may be amended or modified only by mutual written agreement.

10.9 Waiver. No waiver of any provision of this Agreement shall be deemed to be a waiver of any other provision. No waiver shall be binding unless executed in writing by the Party making the waiver.

10.10 Third Party Beneficiary. Nothing in this Agreement, whether express or implied, is intended to confer any rights or remedies on any persons other than the Parties and their respective successors and permitted assigns.

IN WITNESS WHEREOF, the undersigned have executed this Agreement as of the day and year first above written.

[redacted] [redacted]

By: _____ By: _____

Name: Name:

Title: Title:

About the Authors

BioResource Management, Inc. is based in Gainesville, Florida and provides a range of services related to project development and facility operations for biomass industry developers, investors, and landowners. BioResource has over thirty years of experience in forestry, agricultural and urban biomass projects, including site identification and assessment, biomass production, logistics, procurement and management for both the biofuels and bioenergy industry.

Dougherty & Dougherty Forestry Services, Inc. is a full-service forest management consulting firm serving forest landowners, investors, and industry with offices in Wake Forest, North Carolina, Athens and Waycross, Georgia and Daphne, Alabama. Services include: forest management, forest inventory and appraisal, investment analysis, due diligence, feasibility, and research.

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P. O. Box 819
Macon, GA 31202
1-800-GA TREES
GaTrees.org

Funding for this publication provided in part by the U.S. Forest Service
http://www.cnpp.usda.gov/nondiscriminationStatement.htm