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Pathways to Sustainability

An Evaluation of Forestry Programs to Meet European Biomass Supply Chain Requirements

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Executive summary

International trade in wood biomass for bioenergy is expanding as European demand for electricity and heat production increasingly draws wood fuel from North America. As of the first quarter of 2012, relatively few producers in the U.S. ship to Europe, yet there are signals that more companies plan to do so and are now assessing suitable supply areas, sites, and transportation options. In particular, the southeastern U.S. seems poised to expand wood pellet and chip production for the European export market.

Binding and non-binding European sustainability criteria have led to an array of sustainability initiatives and certification systems endorsed and developed at the country level, some by the biomass industry. While wood from North America is often considered lower risk from a global wood supply perspective, this perception may not exempt U.S. sources from these criteria. Companies in the U.S. intending to supply European markets are already encountering an array of expectations, policy uncertainties, and potential risks—most of which are negotiated in supply contracts with European buyers.

A major policy uncertainty is whether the European Union will adopt EU-level sustainability criteria for imported pellets and wood chips, and what these criteria may include. The European Commission has yet to formally declare what requirements may or may not apply to pellet and wood chip imports. In the absence of a formal declaration, current U.S. pellet exporters have announced different claims of supply chain sustainability, or their intent to achieve such claims (e.g., SFI & FSC). The focus of this report is to: (1) explain the uncertainties of existing import requirements and the options that can help this sector avoid controversial sourcing; and (2), present the ways companies can reduce actual or perceived risks that sourcing may have on biodiversity, water resources, and other natural resource values.

This report is intended to be a resource for pellet producers, forest management professionals, landowners, and others concerned with the conservation and sustainable management of U.S. forests. It describes four potential pathways for making sustainability claims, each of which represents a different approach to mitigating environmental and other risks in the supply chain. These pathways are not mutually exclusive and may be adopted together, depending on the options preferred by producers. The four pathways described are:

1. Certified forest management
2. Controlled and mixed sourcing
3. Inspected compliance with stewardship plans and best practices
4. Uninspected compliance with stewardship plans and best practices

The terminology used to describe these pathways borrows terms used in voluntary, regulatory, and market-based programs currently applied to the management and sourcing of other forest products. The pathways themselves do not refer to a particular system (e.g., certification program, stewardship program, etc.), however we do assign these systems to each of the pathways and evaluate the scope of the sustainability issues they each address.

While each of these pathways mitigates environmental risks to varying degrees, the pathways collectively encompass a range of approaches suitable for the diversity of forests and land

Photo courtesy Drax Power Limited

European utilities import wood pellets from U.S. forests to meet EU renewable energy goals. European bioenergy companies often view biomass sustainability as the largest unquantified risk in their supply chain.

ownership types—suggesting that more than one approach to sustainability may be appropriate. For example, at present, certified forest management applies to only 17% of the landscape in the southeastern U.S. Additional pathways will be needed to address the 83% of forests that are not currently certified.

This report also provides a comparison of the major European energy sector sustainability schemes, and how they relate to the four pathways in the U.S. forest sector. Our objective is to clarify how these pathways can help U.S. pellet producers meet the expectations of different European customers, the environmental community, and European sustainability criteria, binding or otherwise.

European bioenergy companies importing wood pellets and chips often view the sustainability of their biomass supply as the largest unquantified risk to their business. Tracing material back to the source is a cost of doing business in all wood products markets, but in many cases, these costs are just beginning to be understood for international wood energy markets. While costs will likely vary for each sourcing pathway, there is clearly an opportunity for early actors to innovate in this marketplace.

Each of the pathways for sustainable sourcing explored in this report relies on certain mechanisms of assurance such as: standards for the production and transport of biomass; third-party verification of conformance; programs of outreach and training; requirements for documentation; and analysis of supply chain impacts. The way in which pathways combine and utilize these mechanisms is a main factor in how well each pathway addresses risks along the supply chain, and ultimately, how well the pathway meets the expectations of buyers.

While certain pathways address many of the standards established in Europe, we find that few do so completely. Recent European bioenergy certification programs claim to address a wide range of sustainability issues from greenhouse gas emissions to forest management. Forest management and chain-of-custody certification systems appear to be the best way to satisfy EU-wide and country-level requirements for low-risk sourcing strategies and sustainability criteria. Even so, the forest certification systems and other sourcing pathways in place do not satisfy the need to perform lifecycle greenhouse gas emissions calculations or related provisions to avoid sourcing from lands high in carbon stocks as specified in European policy.

CHAPTER 1

Introduction

International markets for forest biomass are rapidly expanding in response to European energy policies. This report identifies biomass procurement pathways currently operating in the U.S., and evaluates how well these pathways address European expectations for sustainable sourcing. We reflect on many of the pathways used to encourage sustainable forestry and responsible biomass procurement and consider how sustainability requirements linked to market drivers might influence biomass suppliers in the U.S.

Market actors are the key audience of this report, especially wood pellet and wood chip exporters and their European buyers. The information in this report is intended to help these market actors: (1) make informed choices by understanding the array of procurement pathways available and the claims that can be made by adopting various options, (2) determine how well their current fiber procurement practices align with the requirements of various sustainable procurement models, (3) anticipate how the evolving European policy sphere might impact their procurement strategies, and (4) offer a "pathway to sustainability" that will lead to documentable improvements in procurement practices.

Our goal is to foster thoughtful discourse and help ensure that production and procurement of forest-derived biomass occurs in a sustainable manner with four readily adoptable procurement pathways.

After a brief discussion of market scale and supply chain dynamics presented in Chapters 2 and 3, Chapter 4 offers an overview of the sustainability provisions included in European policy drivers, followed in Chapter 5 by a review of the various European sustainability schemes that have emerged. Chapters 6 and 7 focus on how common forest management programs and practices intersect with the business of biomass procurement in the U.S., discussing the coverage and effectiveness of forest certification systems and various voluntary and compliance-driven programs and practices promoting forest sustainability. Much of Chapters 6 and 7 focuses on the coverage of these programs in the region of the U.S. experiencing the most significant growth in the biomass export sector, the southeastern U.S.

The comparison of programs, practices, and management systems presented in Chapters 3 through 7, as well as related information in the appendices, illuminates potential opportunities to fill sustainability gaps that often occur when emerging markets experience accelerated growth. Our goal is to foster thoughtful discourse on these issues and help ensure that production and procurement of forest-derived biomass occurs in a sustainable manner. To this end, Chapter 8 introduces four readily adoptable procurement pathways, each offering biomass exporters varying options to effectively mitigate environmental risks associated with biomass procurement, allowing certain sustainability claims to be made.

CHAPTER 2

Background

Expanding international markets for biomass

The U.S. wood biomass for energy market space has changed substantially in recent years. In 2011, 13 companies (mostly focused on biopower) exited the U.S. wood bioenergy sector in response to continued policy uncertainty, challenging economics, and public scrutiny. Despite this, the nation saw a net increase of 39 bioenergy facilities from August 2010 to August 2011, while demand for biomass in the U.S. grew by 38%.[1] A rapidly expanding segment of the bioenergy sector is pellet facilities shipping to Europe.

While Europe represents the largest source of demand for densified wood pellets and wood chips for energy, Asian states, such as South Korea, Japan, and China,[2] are also speculating in North American wood baskets. European demand is linked to the European Union Renewable Energy Directive (EU RED) renewable portfolio goal (20% by 2020) and the greenhouse gas (GHG) reduction commitments of member states. The Nordic states, the UK, Belgium, and the Netherlands are expected to be among the major importers of industrial grade wood pellets. Projected European biomass demand over the next 20 years ranges from 35–315 million tons, with estimates of imports accounting for 16–60 million tons of this volume (Joudrey 2012). This wide range of estimates results from reported country-level commitments to bioenergy expansion, which does not identify the source of future wood supplies. There is great

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Expanding European markets for biomass are drawing on U.S. forests for wood pellets, a preferred feedstock for EU renewable electricity production.

uncertainty about where the wood will ultimately come from and how supplies will be constrained by sustainability requirements.

In the short-term, potentially more than 6 million tons of wood pellets will be bound for power plants in the United Kingdom (UK) from the southeastern U.S. in the next 5–10 years (PIC 2010).[3] Take for instance the Tilbury Power Station; a 750 MW coal-fired power plant in the UK will operate using biomass for the next few years prior to decommissioning. If retooled to run on 100% wood, this massive power plant would consume as much as 3.75 million tons of wood pellets annually. If the supply for this plant were to come exclusively from natural forests operating on a sustained yield rotation in the southeastern U.S., this plant would need to draw from 4.7 million acres[4] each year.[5] Supply chains are being set up to meet the demand of this facility.

New markets for low-value wood biomass hold great promise. However, successfully reaping the benefits and avoiding unintended consequences is a difficult balancing act.

The 13-state southeastern region (TX, OK, LA, AR, MS, TN, KY, AL, GA, FL, SC, NC, VA) of the U.S. is expected to see the greatest boom in biomass development over the coming years. In fact, the Southern Forest Futures Project[6] of the USDA Forest Service forecasts that harvesting wood for energy in the south will increase between 54% and 113% by 2050. New markets for low-value wood biomass hold great promise to be a positive influence on forests and an economic development tool for rural economies. However, successfully reaping the benefits and avoiding unintended consequences is a difficult balancing act.

Forestland in the south

The vast majority of private forestland in the South is privately owned by 5 million families, individuals and businesses. Of the 200 million acres of private forests in the South, 134 million acres (67%) is owned by families and individuals (i.e., non-industrial private forest owners, (NIPF)). Only 3% of family forest owners in the South have a written forest management plans (FMP) and only 13% have received forest management advice (Wear et al. 2002). The majority of NIPF lands in the U.S. are not participating in forest certification programs. The situation is very different in Europe where 77% of forests are managed under an FMP or equivalent.[7]

Large industrial landowners in the South divested most of their lands in the last two decades, which has broad implications for the sustainability of these lands, many of which were certified under the SFI forest management standard by the pulp and paper industry. As the paper industry recedes in the South, certified fiber that was previously contracted may become available for pellet production. It remains to be seen if a strong export market for pellets can help maintain these lands under sustainable management into the future.

CHAPTER 3

The biomass supply chain

Biomass procurement resembles traditional wood procurement. Wood exchanges ownership, the harvest or collection of purchased timber and/or biomass takes place, which is likely followed by primary processing (e.g., grinding or chipping at the landing), wood chips and/or roundwood is then transported by any number of means (i.e., truck, rail, barge, freight) to the point of energy production and/or processing into densified wood fuels (bricks, pellets, or liquids).

Biomass supply chains can be complex involving multiple primary and secondary wood processing facilities, timber dealers, aggregation facilities, and direct purchase of residues and low-grade roundwood from multiple logging contractors. Along the way wood is often processed, chipped, mixed, reprocessed, and bought and sold, sometimes repeatedly (COWI 2009). Claiming that a supply chain meets established sustainability criteria requires understanding the full lifecycle of wood fiber along the supply chain. Figure 1 depicts the variety of potential sources of biomass for energy, but does not illustrate the full array of possible relationships and business models (e.g., biomass aggregators, wood dealers, urban wood waste separation/transfer centers) that service the supply chain.

Tracing material back to the source is a cost of doing business for many engaged in wood product markets, but these supply chain systems are just beginning to be defined for energy markets.

Logging residues for example require multiple contractors in harvest, processing, and transportation of the raw material. Because this material is lower value, logging residues transactions can occur with little more than a handshake. In other instances, logging contractors enter into more established and long-term agreements and low value material is traceable along the supply chain in a similar manner as higher value roundwood. The complexity of biomass supply chains increases when energy wood originates from multiple sources (e.g., logging residues, low value roundwood, wood product residues, urban wood), each potentially requiring detailed accounting to determine its origin. Tracing material back to the source is a cost of doing business for many engaged in wood product markets, but these supply chain systems are just beginning to be defined for energy markets.

Typically, biomass feedstocks comprise over half of the total lifecycle cost of bioenergy projects, and as a consequence establishing a biomass supply chain is a top priority for any wood energy or densified fuels facility. Between 20% and 50% of the delivered costs of biomass feedstocks are associated with transport and handling (Altman and Johnson 2009). Costs heavily depend on the complexity of the supply chains. "Middle men"[8] or brokers supplying facilities through long-term contracts will provide storage and handling services that add 10%–20% to the total delivered cost. This may be a small marginal cost to pay if feedstock quality and documentation of environmental performance improves. This sentiment was echoed recently by an official from Drax Power, a larger electric power utility in the UK, who cited biomass sustainability as the company's largest unquantified risk (Gibson, 2012).

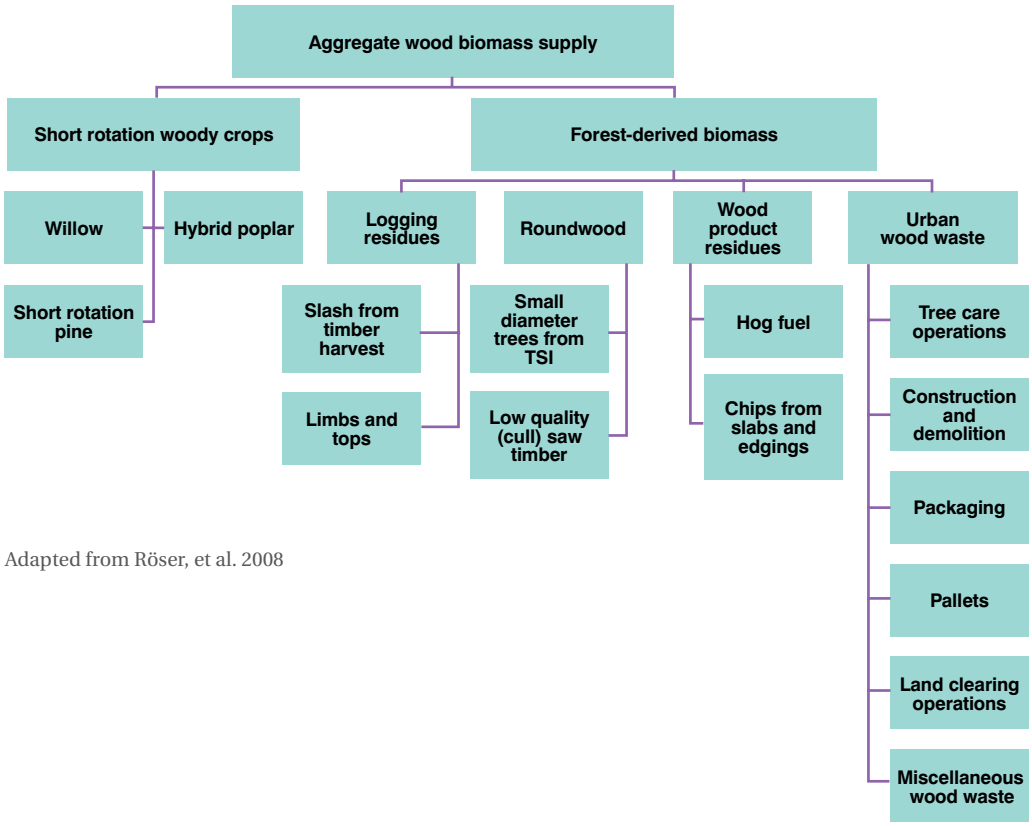
The U.S. biopower industry has historically been a "waste disposal" industry, relying on cheap feedstocks such as urban wood waste and forestry residues that can be delivered at or below $20/ton.[9] The elasticity of demand of densified biomass facilities supplying European energy markets suggests that biomass will likely be procured by wood pellet mills at higher

costs than historically paid by U.S. biopower facilities. These new markets may also more readily absorb higher costs associated with sustainable sourcing, which can be allocated across biomass producers (i.e., landowners, loggers, haulers, and aggregators), processors (i.e., wood pelletization facilities, wood chip suppliers), and end users in Europe.

This report explores how biomass supply chains in the U.S. might develop in response to expectations of European buyers in the areas of forest management and the traceability of feedstocks.

FIGURE 1

Wood biomass sources



Adapted from Röser, et al. 2008

CHAPTER 4

Sustainability requirements in European policy

What will be expected of U.S. pellet makers seeking to supply the European market and which sustainability schemes can be used to meet these expectations? This section contains: (1) a brief overview of the status of European policy drivers and requirements related to imports from the U.S., (2) a description of potentially relevant European sustainability schemes (third-party certification, second-party verification, and green labeling), and (3) an introduction to existing forest certification programs.

The EU Renewable Energy Directive (EU RED) released in 2009 requires each member state to achieve individualized targets for renewable energy production by 2020, so that—in aggregate—the EU produces 20% of its electricity from renewable sources by 2020. While there are EU-level sustainability criteria for liquid biofuels, the European Commission initially decided in 2010 that there should not be binding EU-level sustainability criteria for solid biomass (Report COM (2010)11).[10]

In 2010, the European Commission suggested that individual countries come up with their own criteria for sustainability that follow, at a minimum, the following principles:

- a general prohibition on the use of biomass from land converted from forest, other high carbon stock areas and highly biodiverse areas
- a common greenhouse gas calculation methodology to be used to ensure that minimum greenhouse gas savings from biomass are at least 35% (rising to 50% in 2017 and 60% in 2018 for new installations) compared to the EU's fossil energy mix
- the differentiation of national support schemes in favor of installations that achieve high energy conversion efficiencies, and
- monitoring of the origin of biomass

The EU Timber Regulation also requires that supply chain due diligence be documented for wood imported into Europe that requires documentation of sourcing. Since the original 2010 European Commission decision to exempt solid biomass, sustainability has been actively debated at the EU level and in individual member states. In 2011, the European Commission began looking into whether binding EU-level sustainability criteria for solid biomass are needed. The release of this work is expected soon and may include an explanation of which certification programs and sustainability schemes meet minimum EU-level sustainability criteria. As suggested by Joudrey (2012), it is "probable that certification will become the norm within the EU," but it remains unclear which certification programs will be endorsed as meeting minimum EU requirements. Appendix 1 compares EU-level sustainability criteria for liquid biofuels with the EU voluntary schemes suitable for wood biomass. Assuming that new EU-level requirements for solid biomass will be more stringent than the suggested criteria listed above,

Appendix 1 offers the EU RED liquid biofuels criteria as a proxy for future solid biomass criteria that may be more or less extensive.

The UK policy process offers a window into how the sustainability debate has proceeded at the member state level, with the recently formed UK Biomass All Party Parliamentary Group tackling the issue of sustainability.[11] Taking their cue from the suggested sustainability criteria of the European Commission Report COM (2010)11, the UK Department of Energy and Climate Change requires that beginning in April 2013, renewable electricity facilities receiving renewable obligation credits (ROCs) achieve a minimum 60% GHG emission reduction relative to the fossil fuel mix in the UK. In addition to defining lands from which sourcing will be prohibited, guidance from the UK Department of Energy and Climate Change requires energy producers document the carbon intensity of their feedstocks using a spreadsheet calculator[12] (Ling and Pearson 2011). The UK also restricts the use of biomass sourced from lands with high biodiversity value or high carbon stocks (e.g., primary forest, peatland, and wetlands). These national-level sustainability criteria also include requirements for documenting the chain-of-custody in the supply chain (Ling and Pearson 2011).

Power facilities in the UK are ineligible for ROCs if biomass is derived from land that was *continuously forested or lightly forested* during January 2008 and *was not a continuously forested or lightly forested area when the biomass was obtained from it* (Ling and Pearson 2011). It is unclear what this requirement may mean for biomass produced in clearcuts or other silvicultural regimes and just how individual utilities interpret these rules. At least one buyer in the UK has informed producers they would not source wood removed through clearcut-type harvests.[13] Others do not perceive these kinds of restrictions. How international and national-level sustainability criteria translate to actions in individual supply chains clearly varies greatly.

The combination of forthcoming EU-level minimum criteria for solid biomass and the ISO bioenergy certification guidance would help reduce uncertainties in international wood biomass markets.

At the international level, while supply agreements are being negotiated and executed between U.S. pellet producers and European utilities on the basis of existing sustainability criteria, the European Commission is working to define minimum EU-level sustainability criteria that may be of a more regulatory nature. This process will likely approve voluntary certification programs that meet EU-level standards. At the same time the International Standards Organization project committee (TC 248) is developing standards by which legitimate bioenergy certification programs are to operate.[14] The forms of governance and framework used to track and assess conformance resembles the organization and function of major forest certification programs (FSC, SFI, and PEFC).[15]

The stated scope of ISO TC 248 is: "Standardization in the field of sustainability criteria for production, supply chain and application of bioenergy. This includes terminology and aspects related to the sustainability (e.g., environmental, social and economic) of bioenergy." The ISO project committee operates with four subcommittees: (1) crosscutting issues including terminology and verification audit procedures, (2) greenhouse gases, (3) environmental, economic, and social aspects, and (4) indirect effects. The committee also has liaison with several other ISO committees and external organizations (e.g., FAO and IUCN) and is currently considering whether the Forest Stewardship Council (FSC) ought to be one of these external liaisons.[16] Thirty countries are participating in this process and 13 additional countries are observing the process.[17]

The combination of clear EU-level minimum criteria for solid biomass and the ISO bioenergy certification guidance would help reduce uncertainties in international wood biomass markets. In advance of this, several national-level schemes have emerged in Europe that are in some instances led by the government (e.g., NTA 8080 in the Netherlands), the power industry (e.g., the Green Gold Label, Drax, Laborelec), or stakeholder processes. These systems are outlined briefly in Chapter 5.

CHAPTER 5

European sustainability systems and programs

Our review of sustainability schemes included in this report is based on consultation with industry professionals and a review of published articles, grey literature, and program websites. This review of European sustainability schemes references a growing literature on bioenergy sustainability criteria and indicators,[18] finding that there are as many as 44 different national and international programs aimed at ensuring the sustainability of bioenergy markets (Martikainen and Van Dam 2010). Upon closer examination, only a small number of these programs have relevance in the North American–European trade in energy wood.

Narrowing in on which sustainability schemes and initiatives are relevant to the trade in forest biomass between North America and Europe, we compare the scope and depth of these sustainability schemes against an expanded set of sustainability criteria similar to the Montreal Process Criteria and Indicators. This comparison is included as Appendix 2. The remainder of Chapter 5 offers brief descriptions of these relevant European sustainability programs. An extended review of these programs is offered in Appendix 1, which is a comparison of EU-level sustainability criteria for liquid biofuels to the criteria included in each of these European sustainability programs.

Forty-four different national and international systems and initiatives address the sustainability of bioenergy markets. Only a small number of these may have relevance for wood biomass imports from the U.S.

Green Gold Label (GGL)[19]

The Dutch electric utility Essent initiated the Green Gold Label certification program (GGL) in 2002 and it has evolved into an international biomass certification system meant to cover all aspects of forest bioenergy from forest to conversion. The GGL is recognized by the Dutch government and is being used in nine different countries. The Green Gold website claims that more than five million tons of biomass have already been certified with the GGL and that more than 25 biomass suppliers are GGL certified.[20]

The GGL includes eight separate standards that apply at different points in the biomass supply chain. For instance, GGL S5 and GGL S7 are for sourcing wood from forests if and when other external standards (PEFC and FSC) are not used. Standards for processing and transport (GGL S1 and GGL S4) are intended for aggregators and transporters. The CoC approach of GGL S6 is intended to help ensure that energy produced is from GGL certified biomass. The GHG LCA approach in GGL S8 intends to document GHG reductions.

The GGL S5 includes forest management criteria derived from FSC and PEFC, but the system basically defers to the principles, criteria, and indicators of existing forest management certification programs. The GGL S5 is used for sourcing from lands that are not certified for forest management under the SFI or FSC standard. Wood may be sourced from lands using the GGL S5 standard for four years, but after this period the land must be certified under FSC and/or PEFC forest management standards. Lands certified under the FSC or PEFC forest management standards qualify from the start. Once certified biomass is in the supply chain it is addressed by

TABLE 1

Programmatic elements of the Green Gold Label

Does the system follow ISO standards?	Partially. A number of GGL standards do not follow ISO guidance, while the accreditation body and process follow ISO guides.
What is the chain-of-custody approach?	GGL does have a partial CoC system in place. CoC occurs in GGL S1, S4 and S6. Mass balance and track and trace are used.
How are auditors accredited?	Certification Control Union is an accredited certification body who completes audits for GGL.
How are standards set?	Members are equally represented in the standard setting process. Follows ISO Guides. The standard setting process is somewhat opaque.
Can non-certified wood be included in labeled products?	Yes. This depends entirely on the forest management certification system being used.
What are the key verification and assessment procedures?	Field visits are required. External stakeholder consultation is not required. Audits are required annually. Approval of certificate is valid for a maximum of 4 years.

a GGL CoC program. Twenty-one companies are currently using the GGL CoC label including three pellet plants in the southeastern U.S., Enviva, Georgia Biomass, LLC, and Green Circle Bioenergy Inc. The CoC program in GGL S6 contains criteria related to: (1) transport and use of certificates and prescribed indications, (2) control of incoming products, (3) administration, (4) quality control, (5) calculating the percent of GGL material versus non-GGL material (i.e., mass balance calculations),[21] and (6) certification of the processing facility and equipment.

Laborelec[22]

The Laborelec second-party verification system is an internal supply chain auditing system initiated by a Belgian utility to meet national GHG and energy balance requirements for using biomass in existing coal-fired power plants. Laborelec operates two power plants that each consume 350,000 tons of wood pellets annually. The Laborelec system is recognized by the Belgian government and appears to mainly be an accounting process for facilities to comply with national laws. Laborelec is also the electric power representative on the ENPlus Green[23] committee, a coalition of 10 pellet producer trade associations focused on harmonization of sustainability standards across various systems (i.e., DRAX, GGL, and Laborelec) for wood pellets. Additionally, Laborelec chairs the Initiative Wood Pellet Buyers, an effort of major European utilities promoting EU-level adoption of nine sustainability principles, independent verification of compliance with criteria and indicators of these sustainability principles, inspected compliance with chain-of-custody provisions, and the establishment of "cross-compliance of meta standards (PEFC, FSC, etc.)."

In the way of sourcing, the Laborelec system requires an initial report of local and national forest management conditions when establishing a new sourcing area. This initial report is followed by an annual requirement to track the source of biomass, a detailed calculation of the energy and/or GHG balance of the supply chain, and independent audit reports prepared by a second-party verifier, SGS Belgium. The origin of the biomass must be identified and this is the point where the energy/GHG balance equation begins. It is also mandatory to identify and declare suppliers and transporters of biomass in the supply chain (SGS 2011). Enviva is a declared supplier for Laborelec and has adopted the Laborelec standard.

The Laborelec system requires facilities to identify and document whether the pellets are certified, and if so, by which forest management certification system (PEFC, FSC, and GGL). However, certification via FSC or PEFC is not required at the moment. That said, COWI (2009) note that: "The Laborelec pellet standards specifically include requirements that raw

TABLE 2

Programmatic elements of the Laborelec system

Does the system follow ISO standards?	Partially. Laborelec mentions ISO standards in scheme but the verification approach does not follow ISO guidance.
What is the chain-of-custody approach?	A track and trace approach is used that does not cover the whole supply chain. It excludes production of biomass. The CoC system is intended to enable administrative segregation of biomass at the facility. The assessment procedure uses a documentation of loads coming into the facility.
How are auditors accredited?	SGS Belgium does the verification for Laborelec. They are accredited according to various standards setting organizations including ISO.
How are standards set?	The standard setting process does not appear to be an open and inclusive process.
Can non-certified wood be included in labeled products?	Yes. This depends on the forest management system being used.
What are the key verification and assessment procedures?	Field verification is not required in the initial assessment. External stakeholder consultation is not required as part of the assessment procedure. Auditing is done on a per load basis at the facility. Production controls are not required. Labeling is not required. Audits are based on documents (invoices, transport documents, weight scale–gauge records). Inspections are randomized.

materials must be certified by FSC, PEFC-endorsed schemes or hold an approved pre-scope certificate of one of the endorsed forest management certification systems, with the intention of full certification." In lieu of requiring certification of the material, SGS verifies that there is evidence of responsible management of forests including reforestation plans, protections for soil, air, and water, and local enforcement of applicable laws.

Drax[24]

Drax is a UK power utility that is in the process of developing a mandatory sourcing program that will meet the UK requirements beginning in April 2013. According to the Drax website the system will, "comply, at a minimum, with the sustainability requirements being introduced by the UK Government. . . . we will strive to reduce greenhouse gas emissions by at least 70% in comparison to coal-fired generation. Furthermore, we will engage a qualified third party to develop and implement a rigorous programme of audit and verification of biomass supply chains to ensure compliance against these principles and our policy. The initial Drax procurement principles are to:

- Significantly reduce greenhouse gas emissions compared with coal-fired generation and give preference to biomass sources that maximise this benefit.
- Not result in a net release of carbon from the vegetation and soil of either forests or agricultural lands.
- Not endanger food supply or communities where the use of biomass is essential for subsistence (for example, heat, medicines, building materials).
- Not adversely affect protected or vulnerable biodiversity and where possible we will give preference to biomass production that strengthens biodiversity.
- Deploy good practices to protect and/or improve soil, water (both ground and surface) and air quality.

Photo courtesy Drax Power Limited

European utilities, like Drax (pictured above), are developing sustainability programs to meet policy goals and reduce the risk associated with wood biomass supply chains.

- Contribute to local prosperity in the area of supply chain management and biomass production.
- Contribute to the social well being of employees and the local population in the area of the biomass production."

NTA 8080[25]

The Dutch government commissioned the development of sustainability criteria through the "Cramer Commission" around: GHG emissions, competition with food and wood products,

TABLE 3

Programmatic elements of the NTA 8080

Does the system follow ISO standards?	Yes. Standard is recognized nationally by the Netherlands.
What is the chain-of-custody approach?	A partial CoC system is in place. Mass balance, track and trace, and book and claim are all accepted methods of CoC, but using different methods allows the user to make different claims.
How are auditors accredited?	There are six certifying bodies that are able to grant certificates. Auditors are accredited according to ISO Guidance and according to various standards setting organization including ISO.
How are standards set?	The standard setting process follows ISO Guidance. A stakeholder process is used. Standard is formally integrated into Dutch policy framework.
Can non-certified wood be included in labeled products?	Yes. When only residuals are used certification starts with the first owner of the material. Assessment may be limited to a visual inspection at the gate.
What are the key verification and assessment procedures?	Field visits are required annually following initial assessment. The certificate is valid for five years. External stakeholder consultation is required. Labeling is required.

biodiversity, environmental measures, economic prosperity, and social well-being. These criteria are considered the basis for minimum requirements developed into a certification system by the Netherlands Technical Agreement 8080 (NTA 8080) in 2009 and these criteria are required for facilities receiving subsidies (Martikainen and Van Dam 2010). The scheme includes detailed audit procedures NTA 8081.[26]

According to the NTA 8080 supporting documentation, "biomass is considered sustainably produced, if it has been produced according to the requirements of NTA 8080 and can be traced through the supply chain. It should be noted that NTA 8080 does not address possible (negative) indirect effects that biomass production involves."[27] One potential area where the standard is admittedly limited is in the verification of the source of residue materials and/or gatewood.

SWAN label[28]

The SWAN label is widespread throughout the Nordic states. The SWAN label is a product quality certification program to ensure consistency and environmental performance of pellets combusted in residential, institutional, and district energy settings. It is not targeted at large European utilities. The system relies on existing certification programs (FSC and PEFC) in a similar manner to how the GGL relies on these standards.

TABLE 4

Programmatic elements of the SWAN Ecolabel

Does the system follow ISO standards?	Yes. It is an ISO 14024 type 1 Ecolabelling system.
What is the chain-of-custody approach?	The track and trace method is used to document where all of the material coming into a facility is from.
How are auditors accredited?	No accreditation body currently exists.
How are standards set?	Members are equally represented and the standard setting process follows ISO standards.
Can non-certified wood be included in labeled products?	Yes. This depends on the forest management certification system being used.
What are the key verification and assessment procedures?	Field visits do occur as part of this program, but only for the list of raw material suppliers. This suggests that gatewood is excluded from the assessment process, which includes planned and unplanned site inspections. Reporting includes documentation of loads coming into the facility. Labeling is required. External stakeholder consultation is not required. Audits occur on an annual basis.

Green labeling of electricity

Another approach introduced by European electricity distribution companies is green labeling. These labels are generally used on a national level. The vast majority of green labeling programs claim that they require the use of FSC certified wood. These labeling systems tend not to address the carbon balance of bioenergy. At the EU level, the Eugene standard is trying to harmonize the criteria in these labels. Appendix 3 provides an overview of the major green electricity labeling programs currently of relevance for biomass.

CHAPTER 6

Forest certification systems in the U.S.

Forest certification systems can be thought of as, "a system of standards, rules and procedures for assessing conformity with specific forestry requirements" (CEPI 2004). These systems generally contain: forest management certification standards (e.g., principles, criteria, and indicators, or similar nomenclature), a certification process—the procedures by which a third party evaluates performance against the system's forest management standards, an accreditation process through which third-party auditors are deemed as competent to carry out certification audits, and mechanisms to control claims—such as procedures to enforce rules for entities making claims about their environmental performance relative to a particular standard (Vis, Vos and Van den Berg 2008; Viana 1996; Wintle and Lindenmayer 2008).

Over the last 20 years, public pressure led the forest products sector to adopt forest certification systems to help ensure that the wood they use is removed from forests in a sustainable manner that safeguards critical ecosystem services and provides social benefits (Viana 1996). These systems have evolved over the last two decades and have been heavily influenced by a set of ISO guides (specifically Guide 59, 62, 65, and 66) that lay out the methods by which a certification body is set up and run. Additionally, third-party auditors must follow the ISO criteria for auditors of environmental management systems (ISO 19011).

Over the last 20 years, public pressure led to forest certification systems that help ensure wood harvested from forests is done in a sustainable manner that safeguards critical ecosystem services and provides social benefits.

The FSC and Programme on the Endorsement of Forest Certification (PEFC) are global certification initiatives with an international governance structure and membership, which oversee and endorse national-level initiatives. The FSC-US national initiative and the Sustainable Forestry Initiative SFI, a PEFC-endorsed national initiative, are evaluated in this report. In addition to certification of forest management activities, the PEFC, SFI, and the FSC rely on labeling of certified wood products to communicate to consumers the amount of wood in a given product that can be traced back to forests certified under the system's forest certification standards. There are strict guidelines for the use of labeling and third-party audited standards in place to document the chain-of-custody (CoC) of wood.

For products that do not contain a 100% pure homogenous mix of wood certified to the standard in question, both PEFC and FSC offer alternative approaches and labels. These include physical separation of certified wood from non-certified wood during processing on through to delivery of final product, and labeling approaches for various mixtures of certified and uncertified wood. As described below, in the U.S., FSC and PEFC use different processes for assessing and documenting percentage mix claims and specifically the incorporation of non-certified wood into the supply chain. A recent review of forest certification in the U.S. South by Lowe et al. (2011) also offers a useful comparison between programs.

TABLE 5

Programmatic elements of the FSC system

Does the system follow ISO standards?	Yes.
What is the chain-of-custody approach?	Physical separation or percentage based approach using mass balance calculation and using documentation to track and trace material to its origin.
How are auditors accredited?	The FSC accreditation program is based on (and largely conforms with) ISO 61. Certifying bodies are accredited by FSC's Accreditation Services International (ASI).
How are standards set?	Members are equally represented in the standard setting process. Follows ISO Guides.
Can non-certified wood be included in labeled products?	Yes. Percentage mixes can be included if suppliers of non-certified wood are independently verified as meeting FSC's Controlled Wood standard.
What are the key verification and assessment procedures?	A multi-discipline audit team reviews documents and conducts field audits. External consultation of stakeholders is required. Audits occur on an annual basis. Certificates must be renewed within five years of award. Labeling is required.

Forest Stewardship Council (FSC)[29]

The FSC is an independent, non-profit organization that promotes responsible forest management of public and private forest lands across the globe. The program offers three types of certification: (1) forest management certification, in which individual land management units are certified, (2) forest manager certification, in which a forester agrees to manage a private forest (or a group of private forests) according to FSC standards, and (3) chain-of-custody certification, in which the entire process of forest product development is certified along the supply chain (i.e., foresters, loggers, mills, etc.). The FSC standards are organized into 10 principles and more than 50 associated criteria and numerous companion indicators, which are used by third-party auditors to evaluate forest management activities. The FSC develops national and regional forest management standards and undertakes the accreditation of third-party certifying entities, which in turn audit the performance of a forest management unit against FSC forest management standards.

FSC management standards for the U.S. do not specifically discuss biomass harvests as a particular type of removal, as FSC feels that the key environmental considerations associated with biomass are addressed by their standard. For example, principle 6 addresses the environmental impacts of harvesting operations, and indicator 6.3.f requires that "management maintains, enhances, or restores habitat components and associated stand structures, in abundance and distribution that could be expected from naturally occurring processes," which includes "live trees with decay or declining health, snags, and well-distributed coarse down and dead woody material" (Evans, Perschel and Kittler 2010). Most small landowners cannot afford to seek FSC forest management certification for just their landholdings, but the program does allow for the grouping of several small parcels to receive FSC certification when they are managed by a single FSC certified forester or an organization that obtains an FSC certificate. This can theoretically spread the costs of certification and auditing across more acres, potentially increasing access to certified fiber (Bowyer et al. 2011).

The FSC standard can be challenging for intensively managed forests. Principle 10 of their standard is focused on plantations, and requires clear justification for management activities, protection of "natural forests," species diversity, and long-term site protection. The definition of natural forests applies to forests that have seen limited human intervention,

The Wild Center

Certified forest material provides a low-risk supply of wood pellets for European utilities. Locating enough certified supply of wood biomass from the southeast U.S. may prove difficult as EU demand for wood pellets increases.

suggesting that most of the second growth forests in the south are not included in the FSC definition of natural forests. Principle 10 is less prohibitive than many believe it to be. As long as plantations were not established after November 1994 this type of forest may still be certified. In the event that the conversion took place after the cutoff date, but the current owner is not responsible for this conversion, the plantation may still be eligible for certification. Another principle that is unique to the FSC standard is the exclusion of genetically modified trees.

FSC allows for heterogeneous mixtures of certified and non-certified material under its mix label. Non-certified material must meet FSC's independently verified Controlled Wood standard[30] which specify that the following five potential supply categories be avoided: (1) illegally harvested wood, (2) wood harvested in violation of traditional and civil rights, (3) wood harvested in forests in which High Conservation Values (areas particularly worth protecting) are threatened through management activities, (4) wood harvested from areas where the conversion of natural forests has taken place, and (5) wood harvested from areas where genetically modified trees are planted.

Sustainable Forestry Initiative (SFI)[31,32]

Currently an independent certification program, SFI was originally established by the American Forest and Paper Association (AF&PA), as a means to help ensure that AF&PA members use responsible forest management practices. The SFI certification system is a U.S. national initiative endorsed by the Programme on the Endorsement of Forest Certification Programs (PEFC). The SFI system operates in a four-tiered approach of broad principles, 20 objectives, 38 performance measures, and 115 indicators. Two broad types of activities are covered under the SFI system, forest management and the sourcing of wood fiber (i.e., chain of custody and Fiber Sourcing). Forest management is covered by objectives 1 through 7 and 14 through 20, which encompasses 31 performance measures and 94 indicators. The Fiber Sourcing protocol is addressed by objectives 8 to 20, which includes 15 performance measures and 56 indicators.

At the level of objectives SFI includes reforestation, protection of water quality, enhancement of wildlife habitat, improvement of harvest operation aesthetics, protection of unique sites, considerations for biological diversity, continued improvements in wood utilization, and the responsible use of pesticides and fertilizers. The SFI objectives and performance measures do not include specific protocols for biomass harvesting. The SFI system has an emphasis on training of actors in the supply chain, which is required for facility procurement officers; certified entities are strongly encouraged to provide training for forest managers and loggers (e.g., BMP training). Scientific research and adaptive management is another emphasis.

The Fiber Sourcing standard is the means through which fiber that is not certified can be mixed with certified fiber, allowing certified entities to claim a mass balance percentage mix of the product is certified and thus label it as such. The basic structure and requirements of Fiber Sourcing include:

- promotion of responsible forest management landowner outreach, logger training and research activities.
- avoidance of controversial sources.
- maintaining a list of certified logging (e.g., master logger certified) professionals and qualified logging professionals. The list must be maintained by the program participant, an appropriate state agency, loggers' association or another organization.
- establishment of systems that generate verifiable information pertaining to wood purchased by program participants from land outside the owner's control. Establishment of a system that characterizes the area from which wood supply originates, and assess data that accurately reflects the conditions on the ground related to the wood coming to their facility. This may include a process of tracking wood supplies back to the tract of origin, or use of sufficient statewide monitoring programs and other regional data if the participant can demonstrate that the data are: (a) credible and independently verifiable, and (b) relevant to and reflective of the participant's specific operations (SFI 2012).

Photo courtesy Drax Power Limited

Certification systems provide a high level of risk-mitigation for EU policy and sustainability indicators. Certification has become a preferred, though limited, procurement pathway for EU wood pellet suppliers.

TABLE 6

Programmatic elements of the SFI system

Does the system follow ISO standards?	Yes.
What is the chain-of-custody approach?	Physical separation or percentage based approach using mass balance calculation and using documentation to track and trace material to its origin.
How are auditors accredited?	The SFI accreditation system is nationally recognized in the U.S. and follows ISO Guides. The ANSI-ASQ National Accreditation Board (ANAB) accredits auditors.
How are standards set?	The SFI Board updates the SFI Standard every five years following an open public review process, and based on recommendations from volunteer, multi-stakeholder committees. The SFI Board has equal representation by environmental, social, and economic sectors and is the only body that can modify the standard. Follows ISO Guides.
Can non-certified wood be included in labeled products?	Yes. Percentage mixes can be included using the SFI Fiber Sourcing program.
What are the key verification and assessment procedures?	Document review and field audits are required. Consultation of external stakeholders is required. Annual surveillance audits are required. Certificates must be renewed within three years of award.

American Tree Farm System (ATFS)[33]

The American Tree Farm System is a certification program designed to help family woodlot owners develop and implement a forest management plan that includes: the owners' goals appropriate to the management objectives, a tract map noting stands and conditions, important features including special sites, and management recommendations that address wood and fiber production, wildlife habitat, owner-designated fish, wildlife and plant species to be conserved/enhanced, threatened and endangered species, high conservation value forests and other special sites, invasive species and integrated pest management environmental quality, and, if present and desired by the landowner, recreational opportunities (AFF 2010). The ATFS standard also includes periodic monitoring to encourage landowners to monitor for changes that could interfere with their management objectives. After the forest management plan is developed, the

TABLE 7

Programmatic elements of the ATFS

Does the system follow ISO standards?	Yes.
What is the chain-of-custody approach?	CoC procedures comply with PEFC requirements.
How are auditors accredited?	The ANSI-ASQ National Accreditation Board (ANAB) accredits ATFS auditors.
How are standards set?	An independent panel of stakeholders sets standards every five years. These are then approved by the American Forest Foundation Board of Directors.
Can non-certified wood be included in labeled products?	NA
What are the key verification and assessment procedures?	ISO accredited auditors assess ATFS compliance to PEFC through annual national surveillance audits. Every fifth year ATFS undergoes a PEFC compliance audit. Annually, a random sample of properties receives a visit from a volunteer inspecting forester.

property is inspected by an ATFS volunteer forester annually to verify whether the management plan is being implemented. Using a random sampling process annually, selected properties are inspected by volunteer foresters as part of ATFS's internal monitoring program.

The ATFS does not have its own CoC certification, however it does offer CoC through PEFC. The ATFS is endorsed by PEFC, meaning that wood fiber from ATFS certified forests can be counted as certified content for the SFI label. Third-party certification audits are required under ATFS. These are carried out annually by ANSI-ANAB accredited auditors.

The ATFS and SFI comprise around 84 million acres across the country, or 87 percent of all certified forestland in the U.S. Over half (53%) of ATFS certified acres occur in the South. Despite this, the amount of ATFS certified acres in the region is only 10% of all NIPF lands in the South.

Council on Sustainable Biomass Production (CSBP)[34]

This third-party certification program was developed through the collaboration of several environmental organizations and energy and forest industry interests. The program is intended to regard the full chain-of-custody (from feedstock production to energy generation) of both the biofuels and bioenergy industries. A draft standard for feedstock production has been released, and a standard for energy conversion facilities is currently under development. The feedstock production draft standard applies primarily to agricultural landowners, and its applicability for smaller landowners is not clear.

The program was originally conceptualized as a way to ensure that the short-rotation energy crop plantations of the burgeoning liquid transportation biofuels industry are grown in a manner that complies with the Clean Water Act and the recent U.S. EPA liquid biofuel GHG emissions threshold requirement of the federal Renewable Fuels Standard. The CSBP standard addresses a wide range of principles including: land management planning, soil quality, biological diversity, water quantity and quality, lifecycle GHG emissions, and socioeconomic considerations (e.g., labor law compliance). Additional topics covered in the draft standard include land conversion, invasive and non-native species, and a number of agricultural practices related to agro-chemical inputs.

Even if European demand sends a clarion call for certification, the reality is that only 17% of southern forests are certified, signaling a potential market failure if facilities are unable to procure only fiber certified under forest management standards.

Forest management and chain-of-custody certification in the southeastern U.S.

As previously discussed, forest certification systems are well established within the forest products sector. However, it remains unclear as to how the various permutations of certification (i.e., FSC CoC, SFI CoC, SFI Fiber Sourcing, FSC Controlled Wood, SFI Forest Management standard, FSC Forest Management standard, the American Tree Farm System) will ultimately be viewed by European buyers. Both PEFC and FSC are commonplace in Europe. Moreover, with the new European Timber Regulation and the Report COM (2010)11 both calling for chain-of-custody tracking for biomass, it seems likely that in the least CoC certification will be seriously encouraged by European wood pellets buyers.

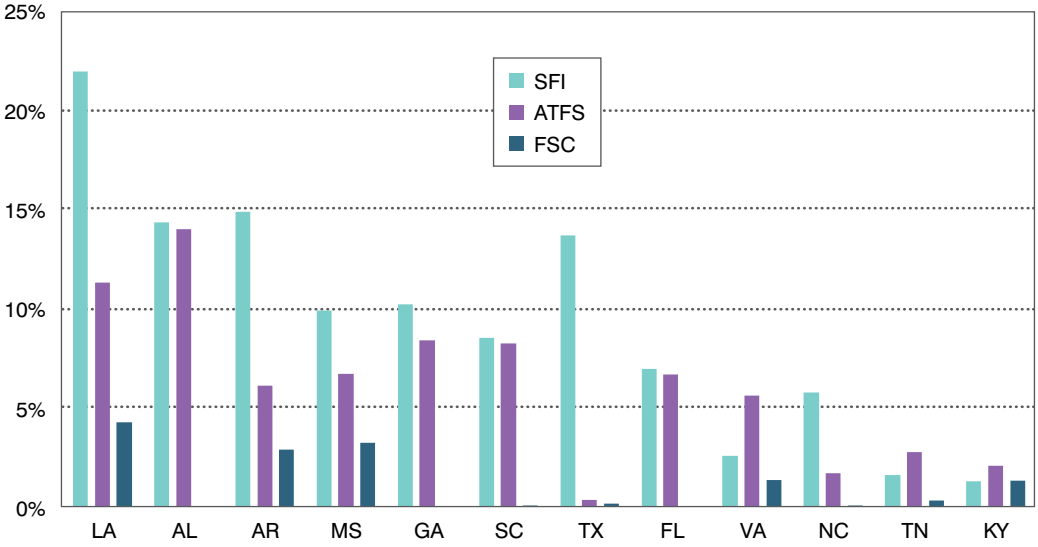
Still, even if European demand sends a clarion call for certification, the reality is that only 17% of southern forests are certified (9.6% SFI, 1% FSC, and 6.3% ATFS), signaling a potential market failure if facilities are unable to procure only fiber certified under forest management standards.

Costs of certification can vary based on program differences and case-specific issues. When Duke University (8,000 acres), North Carolina State University (4,500 acres), and the North Carolina Department of Forest Resources (42,000 acres) decided to dual certify their lands to SFI and FSC forest management standards (in 2000), the cost of certification audits across this total 54,500 acres was ~$70,000 for FSC (~$1.30/acre) and ~$36,000 for SFI (~$0.70/acre). Cost discrepancies at the time related to differences in the size of the audit teams and the scope of the audits. There is less cost discrepancy now, and in general audit costs are lower but greatly dependent on land area.

The main costs involved are preparation, initial inspections, remedial actions, follow-up inspections, ongoing management improvements, record keeping, etc. Forest certification also includes the cost of required management changes, which can be significant if lands have previously been unmanaged or managed poorly (Cubbage et al. 2002). The Southern Group of State Foresters recently articulated that annualized per-acre costs for ownerships less than 10,000 acres is $15 for SFI and $3 for FSC (Lowe et al. 2011).

FIGURE 2

Percent of total forestland in southern states certified by FSC, SFI, ATFS



Source: Lowe et al. 2011

TABLE 8

Acres of forestland certified by state and program

	Total forestland	Acres SFI	Acres ATFS	Acres FSC
Louisiana	14,221,733	3,129,004	1,610,198	603,584
Alabama	22,692,817	3,255,868	3,181,418	6,074
Arkansas	18,829,891	2,805,293	1,150,676	539,533
Mississippi	19,622,417	1,946,526	1,313,304	634,064
Georgia	24,783,744	2,532,586	2,083,638	—
South Carolina	12,745,895	1,086,784	1,050,359	6,865
Texas	17,273,287	2,368,824	59,161	26,809
Florida	16,146,905	1,121,313	1,076,054	120
Virginia	15,765,707	406,552	884,416	209,683
North Carolina	18,446,595	1,065,980	311,627	10,455
Tennessee	14,480,278	231,868	398,919	42,371
Kentucky	11,970,446	152,000	247,785	156,757

Source: Lowe et al. 2011. Data were obtained from each certification program's certificate and/or verification databases.

CHAPTER 7

Other relevant programs operating in the southeast U.S.

Regulatory and non-regulatory programs in the South

Regulatory approaches (procedural rules, legislatively prescribed practices, reporting, monitoring, compliance, and enforcement) and non-regulatory approaches (extension education, information sharing, technical assistance, tax incentives, and other financial incentives), have both proven to be useful means of influencing the management of private forests (Ellefson et al. 2004). Most states in the region rely on a small framework of water and forestry laws focused mainly on a variety of issues (e.g. water quality, fire management, pest management, and restocking) that are bound together by voluntary programs focused on outreach to landowners and loggers. State-level laws are often supplemented by local ordinances that offer a further degree of control over forestry activities at the local level.[35]

In a nationwide review of state-level regulations affecting forestry operations, Ellefson et al. (2004) found that among geographic regions in the U.S., the South has the highest portion of states that have no regulations of practices, or that only regulate under certain conditions. As a consequence, some states rely almost exclusively on voluntary approaches, with the forest industry historically playing a larger role than government in carrying out outreach to land-

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Non-regulatory programs such as water quality BMPs can provide important protections when properly applied and can mitigate some risks for biomass procurement.

owners or providing financial and/or technical assistance in the development of forest management plans (Ellefson, et al. 2004; AF&PA 1993).

Voluntary programs most often take the form of cost share payments, technical assistance, grants and loans, education programs, preferential access to contracts with forest product companies, practice guidelines, and certification programs (Ellefson et al. 2004). Ellefson et al. (2004) found that forestry agencies in the South ranked order of program effectiveness to be: technical assistance, extension education, financial incentives, tax incentives, and regulatory programs.

Best management practices

Approximately 86% of timber harvests nationwide apply Best Management Practices (BMPs). When applied properly, BMPs are an effective tool to maintain water quaility.

Forestry operations are responsible for approximately 10% of water quality impairments in the U.S. This is largely due to sedimentation associated with roads and stream crossings and the improper implementation of BMPs (Edwards 2002). Best Management Practices (BMPs) were developed as a requirement of an exemption granted to silvicultural activities in the non-point source pollution permitting requirements of the Federal Clean Water Act. Each set of BMPs was developed at the state-level using science based information to create guidance on how to protect water resources. Some BMPs include guidance on secondary goals related to soil productivity and wildlife (Aust and Blinn 2004). Overall, BMPs offer guidance on streamside management zones (SMZs), forest roads, stream crossings, timber harvesting, and site preparation. Research has shown that proper BMP implementation can successfully mitigate most long-term water quality impacts related to forestry activities. (See Appendix 6 for a review of BMP programs in the South.)

Even with many of these programs being voluntary, approximately 86% of timber harvests nationwide apply BMPs (Edwards 2002). A 2008 review of BMP program monitoring across the 13 southern states from Texas to Virginia found the rate of BMP implementation to range from 68–99% (a mean of 87%) in timber harvests (SGSF 2008). This study found that individual BMPs[36] are implemented unevenly across the region, with some states reporting considerably higher performance. Monitoring, reporting, and enforcement of BMPs vary from state to state, as does the complexion of these programs. Table 9 shows the variation in state BMP programs across the South. In over half of southern states, BMPs are voluntary with the potential enforcement by a state agency. For example, in Virginia BMPs are voluntary, but landowners and loggers are subject to fines if BMPs are found to not be in use. Only Kentucky, which has a regulatory timber harvesting program, and North Carolina, which has

TABLE 9

Forestry BMP program enforcement in southeastern states

Alabama	Non-regulatory (voluntary BMPs) with potential enforcement
Arkansas	Non-regulatory (voluntary BMPs) with potential enforcement
Florida	Combination of regulatory and non-regulatory
Georgia	Combination of regulatory and non-regulatory
Kentucky	Regulatory (permit process of mandatory BMPs)
Louisiana	Non-regulatory (voluntary BMPs) with potential enforcement
Mississippi	Non-regulatory (voluntary BMPs) with potential enforcement
North Carolina	Combination of regulatory and non-regulatory
South Carolina	Non-regulatory (voluntary BMPs) with potential enforcement
Tennessee	Non-regulatory (voluntary BMPs) with potential enforcement
Texas	Combination of regulatory and non-regulatory
Virginia	Non-regulatory (voluntary BMPs) with potential enforcement

Source: Shepard 2006

mandatory Forest Practice Guidelines, have adopted regulatory approaches to their water quality programs.

A body of research evaluating the removal of biomass during timber harvests highlights the importance of retaining some harvest residues distributed across harvested areas to minimize impacts on soil and water resources (Patric 1978; Shepard 2006; Benjamin 2009; Evans, Perschel and Kittler 2010). Drawing from this research, some BMP programs in the U.S. suggest retaining higher volumes of coarse woody debris than would usually be retained in harvests without BMPs (Benjamin 2009). If implemented correctly existing BMPs should be sufficient to address most water quality concerns during and immediately after biomass harvests (Evans, Perschel and Kittler 2010). However, even if BMPs are successfully implemented, they may be insufficient to address potential risks associated with intensive biomass removal, hence the development of voluntary biomass harvesting guidelines.

Loggers, often operating on tight margins, have expressed negative perceptions of BMPs and biomass harvesting guidelines, mostly due to what they considered unnecessary cost burdens (Fielding 2011). In a study of harvests in Georgia, Florida, and Alabama found the aggregate marginal cost of implementing state BMPs on approximately 4,000 acres of forestland to be around $50,000 or 2.9% of gross harvest revenue (Lickwar 1992). This varied significantly from site to site with steep sites in the mountains being above 7% and flat sites and sites on the Coastal Plain being around 1%. Lickwar estimated the cost of BMPs to be $4.50–$25 per acre with an average cost of $12.45 per acre. A study that completed field testing, the cost of BMPs was found to be $8–$29 per acre for a mean of $19 per acre (Cubbage 2004). Data on the costs of implementing voluntary biomass harvesting guidelines is not yet available due to the newness of these guidelines (Fielding 2011).

Water quality BMPs may be insufficient to address the potential risks associated with intensive biomass removal, hence the development of voluntary biomass harvesting guidelines (BHGs) in recent years.

Biomass harvesting guidelines

Building on existing BMP programs, at least eight states (MO, KY, MD, PA, ME, MI, WI, and MN) have developed voluntary biomass harvesting guidelines that supplement BMPs to include practices that protect soil fertility, wildlife habitat, water quality, and other values during biomass harvests. Similarly, the Forest Guild, a non-profit focused on ecological forestry, has developed regional biomass harvesting and retention guidelines for the forests of the Southeast, the Northeast, and is currently developing guidelines for the Northwest.[37] The Southern Group of State Foresters has also developed biomass harvesting principles. The regional guidelines of the Forest Guild and the state guidelines of Kentucky are presently the only operating in the region, although some aspects of the Maryland and Missouri guidelines may be useful to certain areas of the South. A comparison of the Kentucky and Forest Guild Guidelines to existing state BMP programs is offered in Appendix 6.

The main focus of guidelines is the amount of down woody material (DWM) (i.e., coarse woody debris and fine woody debris) that can be sustainably removed without impairing nutrient cycling and habitat values (Evans, Perschel and Kittler 2010; Fernholz 2009). While the range of DWM retention targets varies in these guidelines—ranging between 15%–35% of potentially harvestable material—the amount that can be sustainably removed depends highly on forest types and site-specific conditions. Because of this, guidelines are structured in a way that encourages foresters and loggers to use their best professional judgment given the information presented to them in the guidelines. The most useful guidelines offer clear targets (i.e., leave one-third of all limbs and tops distributed across less fertile sites[38]) and suggestions related to intensive whole-tree harvesting techniques.

Standard practices have emerged for what can be considered responsible biomass harvesting and these are just now beginning to circulate within the knowledge base of the logging and forestry communities (Evans, Perschel and Kittler 2010). These guidelines are beginning to influence certification audits and could be included in the procurement programs of individual facilities, but this has yet to happen.

Relevant federal, state, and private incentive programs

Some government funded landowner incentive programs may be of relevance for sourcing strategies, particularly those that focus on sourcing from lands operating under a forest management plan. The majority of these programs focus on providing incentives to landowners to undertake and/or implement forest management plans. Appendix 5 categorizes the state, federal, and privately administered programs available to NIPF landowners in southeastern states. On average there are 20 programs available to landowners in each state, some of which, such as the Forest Stewardship Program and Biomass Crop Assistance Program, may be of relevance to pellet facilities seeking to establish a sustainable supply chain.

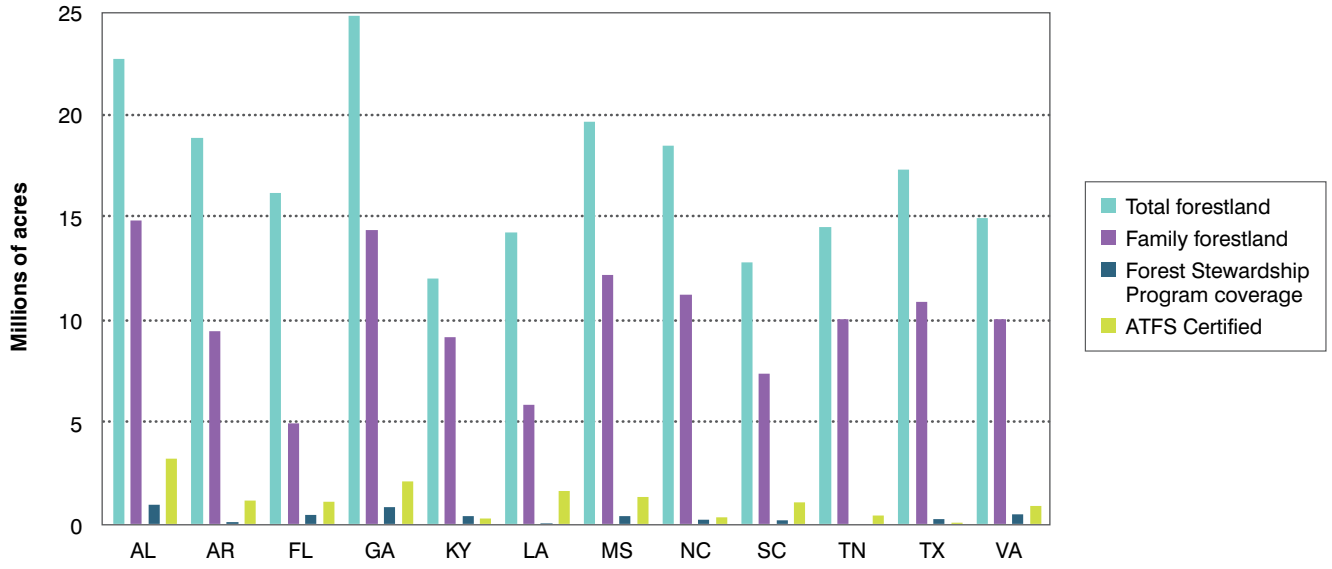
Forest Stewardship Program (FSP)

The USDA Forest Service operates the Forest Stewardship Program which can provide financial incentives to compensate landowners who work with a forester to develop forest management plans (FMPs). These plans also confer eligibility for a broader suite of incentives to implement practices that improve forest productivity and habitat conditions. The vast majority of private forest landowners in the U.S. do not currently have forest management plans, despite the fact that FMPs are widely viewed as one of the most effective means of ensuring responsible management of woodlots.

Plans are usually written for a 10–15 year period by a licensed professional forester and typically include: (1) an articulation of the objectives of the woodland owner, (2) forest inventory data, (3) maps denoting relevant property-specific information (e.g., location, boundaries, individual stands, soil types, tree retention areas, key conservation features, and future harvest areas), and (4) detailed descriptions and chronology of silvicultural treatments for each forest stand (Viana 1996). Many state and federal financial incentives, such as tax abatement programs and Farm Bill programs, require that landowners operate under a current FMP. Overall, coverage of FSP in the south is limited. The program covered just over 4.1 million acres, or roughly 3% of all NIPF lands in the south as of 2010.

FIGURE 3

Acreage of family forestland in southern states compared with acres enrolled in FSP and ATFS



Source: Butler 2008; Lowe et al. 2011; http://www.fs.fed.us/na/sap/products/

TABLE 10

Forest Stewardship Program enrollment by state

State	Forest Stewardship Program coverage (acres)
Alabama	925,552
Arkansas	85,817
Florida	437,823
Georgia	804,311
Louisiana	33,991
Mississippi	385,183
North Carolina	211,651
South Carolina	181,866
Texas	236,009
Virginia	452,118
Kentucky	388,432
Tennessee	Data not available

Source: http://www.fs.fed.us/na/sap/products/

Biomass Crop Assistance Program (BCAP)[39]

The Biomass Crop Assistance Program (BCAP) is perhaps the best-known biomass program from the 2008 Farm Bill. This program authorizes payments to agricultural producers for the establishment, maintenance, collection, harvest, transport, and storage of eligible biomass energy feedstocks, including woody biomass from non-industrial private forestlands.

This program works through identifying the sourcing area (referred to as the project area) for qualified biomass conversion facilities (BCF) such as wood pellet mills, and then providing supply chain subsides effectively lowering the delivered cost facilities pay at the gate. Under BCAP eligible landowners within the project area receive federal payments for biomass delivered to the facility which are based on the average county rental rate for cropland as adjusted for forestland productivity for nonindustrial private forestland. Participating landowners within a BCAP project area may be eligible to receive a forest management plan that covers the acres enrolled in BCAP.

In 2010/2011 the USDA issued rules related to this program after considerable concerns were voiced by multiple entities. These rules specify the process for developing a BCAP project area and securing biomass supplies within that project area. Program documents specify eligibility of lands and biomass type. BCAP proposals must include the following information about the project area:

- a GIS shapefile of the project area. This file must be accompanied by a description of the various biomass activities and land uses, the number of NIPF landowners, and the total number of existing biomass producers in the project area.
- a detailed description of relevant environmental factors, including precipitation, soil, important geological features, vegetation patterns, wildlife, water resources, air quality, Federally listed endangered and threatened species.
- a detailed description of Federal or State assistance or tax benefits being provided to the project area, as well as present and future historical account of biomass commodity prices in the project area.

- analysis of competition for raw material in the supply chain including: (1) the magnitude of forestry-related environmental impacts, (2) expected socioeconomic impacts and description of potential supply chain impacts, (3) past and projected future trends in agricultural and forestry impacts, (4) nature of any health-related agricultural or forestry impacts, (5) past, ongoing, and projected future efforts to address forestry impacts through State and Federal programs, including the number of acres in the project area currently under CRP, EQIP, WRP, and the Forest Legacy Program.

The final requirement for BCAP proposals is a feasibility study completed by an independent qualified consultant that evaluates the feasibility of sourcing biomass for the BCF. Feasibility studies are to consider all economic, technical, and environmental aspects of the supply chain including:

- information about the project site, the availability of trained or trainable labor, and the availability of infrastructure and transportation to the site.
- determination of technical feasibility, financial feasibility, and system management feasibility
- the availability of biomass feedstock (i.e., feedstock source management, estimates of feedstock volumes and costs, collection, pre-treatment, transportation, and storage, impacts on existing manufacturing plants or other facilities that use similar feedstock, and the feasibility/plans of projects to work with producer associations or cooperatives.
- documentation that any and all woody biomass feedstock cannot be used as a higher value wood-based product.

BCAP also requires that a monitoring program be designed and carried out with annual reporting of results. An additional requirement is the need to include public outreach activities to engage biomass producers, biomass industry groups in the state, the power industry, forest industry groups, tribal leaders, conservation and environmental groups. Perhaps the biggest hurdle in the program is the need for a proposed project to comply with the National Environmental Policy Act (NEPA) by completing an Environmental Assessment (EA).[40] If the Farm Services Agency (FSA) determines that the EA is sufficient, FSA will publish a finding of no significant impact (FONSI) or mitigated FONSI that will solicit public input on the proposed BCAP Project Area.

Environmental Quality Incentives Program (EQIP)

This program focused on soil and water quality is the largest and most widely utilized of the Farm Bill programs. Forestry practices eligible for funding include forest health treatments, tree planting and reforestation activities, and FMP development (AFF 2011).

Wildlife Habitat Incentives Program (WHIP)

This Farm Bill program focuses on wildlife habitat improvements with the most frequent practices funded including tree planting, forest health improvement, site preparation, and prescribed burning (AFF 2011).

Conservation Stewardship Program (CSP)

This program helps NIPF landowners manage their forests in a comprehensive manner. The most popular forest practices include prescribed burning, forest stand improvement, and building shelters and structures for wildlife. In 2010, forestland enrollments were strong in the southeast, where Alabama (241,000 acres), Georgia (165,000), and South Carolina (154,000 acres) comprised 27 percent of the entire program (AFF 2011).

CHAPTER 8

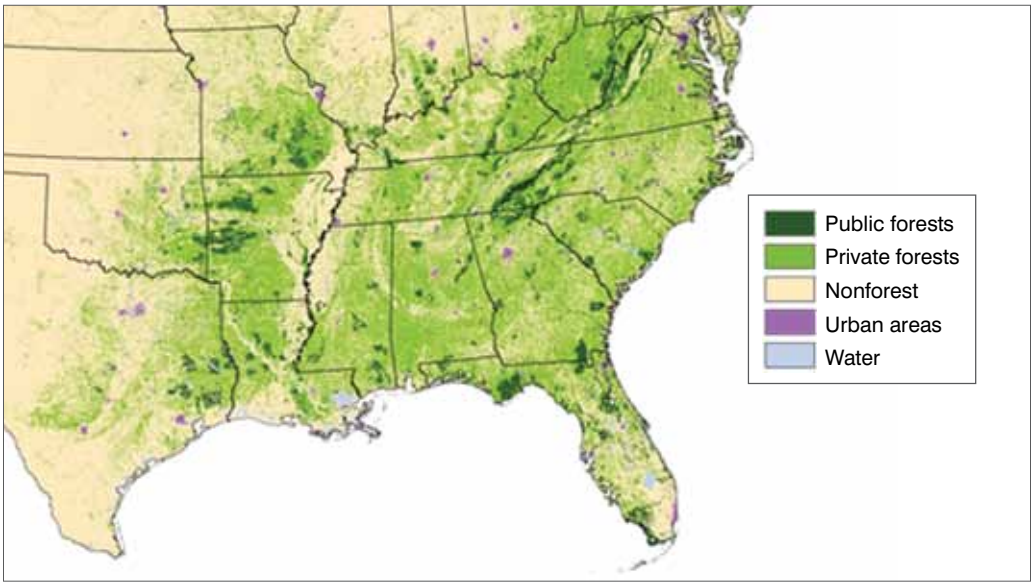
Procurement pathways to mitigate risk

Market structure for biomass exports remains uncertain. Binding EU-level standards for the sustainability of imported materials are in flux. It is highly likely that several pathways, including some currently in place, could be used to achieve and surpass such a regulatory baseline. In theory, Southeast pellet producers will be able to comply with the requirements of the EU Timber Regulation, the broad criteria from Report COM(2010)11, and the EU RED criteria for biofuels if they: (1) trace and document that their supply comes from sources that do not violate certain conditions (biodiverse and carbon dense ecosystems), and (2) calculate the GHG emissions associated with their supply chain. Still, doing these steps does not guarantee compliance with any additional provisions specified in national policies and/or procurement contracts with wood pellet buyers that may specify a different or even higher baseline.

In general, a common approach to estimating the GHG effects of bioenergy has emerged (see Appendix 4), yet significant variations in emissions factors and other variables exist depending on which certification system or policy the supplier is selling their biomass through. Navigating the GHG requirements may prove less difficult than navigating the various pathways discussed

FIGURE 4

Location of private and public forests in the southeastern U.S.



further in this section. Each pathway will afford companies varying levels of assurance when it comes to compliance with criteria and mitigation of supply chain and environmental factors.

Supply chain risks in southeastern forests

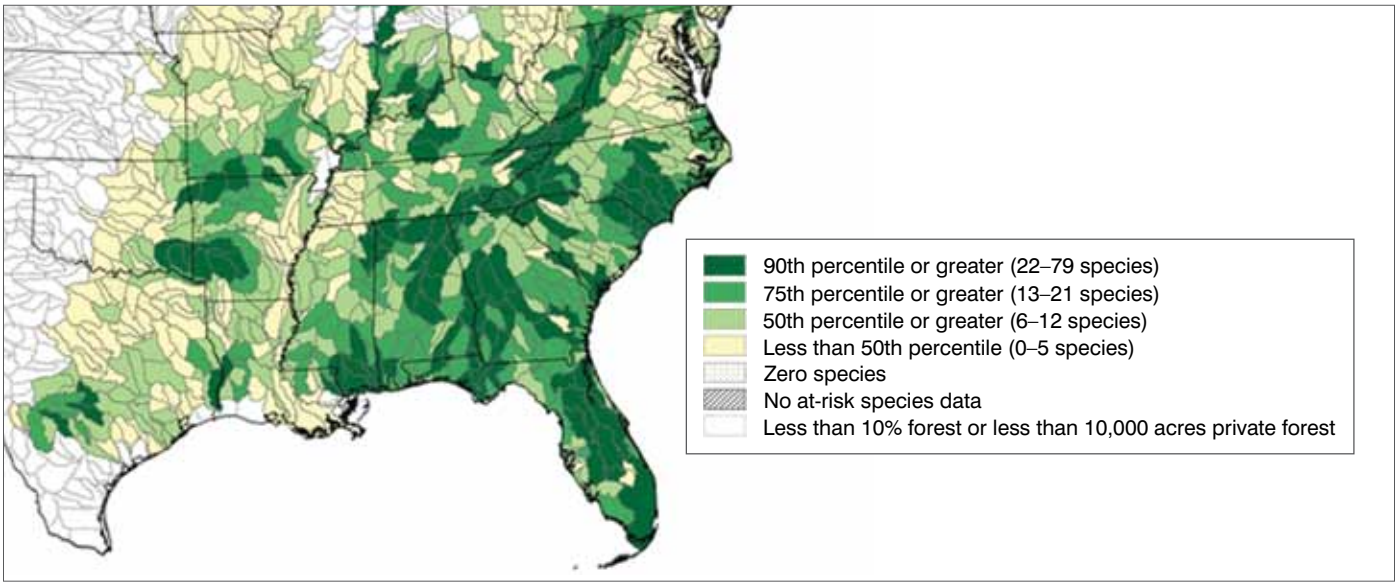
While many hold the perception that forest management and forest operations across the U.S. are sustainable, there are still risks of ensuring that supplies adequately meet sustainability standards and expectations. Perhaps the principal reason domestic wood supplies are viewed as "sustainable" or "low-risk" is that over recent decades in the majority of wood producing regions of the U.S. more wood volume has been accumulating than has been harvested. In this timeframe large swaths of agricultural lands were abandoned and reverted to forests, with the notable exception of conversion of forestland for development in areas of high population growth. Also in this timeframe, states, educational institutions, non-governmental organizations and the forest products industry have promoted sustainable forestry through educational outreach (i.e., programs described in prior sections of this report). As a result, there are more forests, and many more landowners in the U.S. have some exposure to sustainable forest management approaches. Water quality BMPs in particular have been a key component of training and education for landowners, foresters, and logging operators, and in some instances these BMPs also include practices for ensuring the integrity of forest ecological values.

Despite these advances, the southeastern U.S. faces particular challenges protecting key habitat and associated species due to the amount of land that can readily change hands and the species richness that can occur in these same areas (see Figures 4 and 5).[41] The greatest challenge relates to habitat degradation and invasive species, complicated by slow recovery from historic land use (Stein et al. 2010). Many of these factors can be mitigated if biomass suppliers recognize and protect lands of high conservation value, such as areas known or expected to be inhabited by rare, threatened, or endangered species.

Ongoing in-growth of forests and responsible forest management can be part of the solution and sustainable biomass harvests can be a piece of this. Markets that value forests can help keep forestland from converting to another land use. At the same time, increased aggregate demand

FIGURE 5

Number of at-risk species associates with private forest, by watershed in the southeastern U.S.



for fiber supplies and any associated increases in forest conversion may also increase risks to key habitats. Intensification of harvesting techniques at the stand-level, especially in habitats formerly retained during harvests for other wood products (e.g., associated with non-merchantable trees and downed wood), have the potential to jeopardize rare species and ecosystems.

Companies seeking to assure buyers that their sourcing is sustainable have several pathways to consider. Figure 6 depicts four existing pathways by which wood products may be exported as chips or pellets to European markets, their associated environmental claims, and how these claims align with standards developing in Europe. These four pathways are:

1. Certified forest management
2. Controlled and mixed sourcing
3. Inspected compliance for stewardship plans and best practices
4. Uninspected compliance with stewardship plans and best practices

For the purposes of simplifying the potential pathways of fiber sourcing for wood pellets, recycled or reclaimed materials are omitted. While these are often components of certified products, they are not widely included in densified energy wood products.

Four procurement pathways are outlined to supply biomass to European utilities:
1. Certified forest management
2. Controlled sourcing;
3. Inspected compliance of plans and practices
4. Uninspected forest operations

Four pathways to minimize risks and meet European requirements

Figure 6 compares several procurement pathways against the current EU criteria for liquid biofuels. These criteria were selected as a basis for comparing potential pathways because the EU biofuels criteria are currently binding at the international level and set a similar, albeit higher, bar for biomass production than the European Commissions' current suggested criteria for member states. As such, evaluating existing pathways against the EU biofuels criteria is a useful exercise to understand the extent to which current pathways for delivering wood biomass for export markets meet more stringent binding criteria. The four pathways employ the use of BMPs and BHGs, forest management certification programs, SFI Fiber Sourcing and FSC Controlled Wood to certify percentage mixes of certified and non-certified content, inspections and documentation that verifies wood as originating in harvests compliant with voluntary and regulatory forestry programs (e.g., Forest Stewardship planning, BMPs and BHGs), non-documentable and non-inspected wood. Additionally, Figure 6 also depicts four of the European bioenergy certification programs reviewed in Chapter 4 of this report.

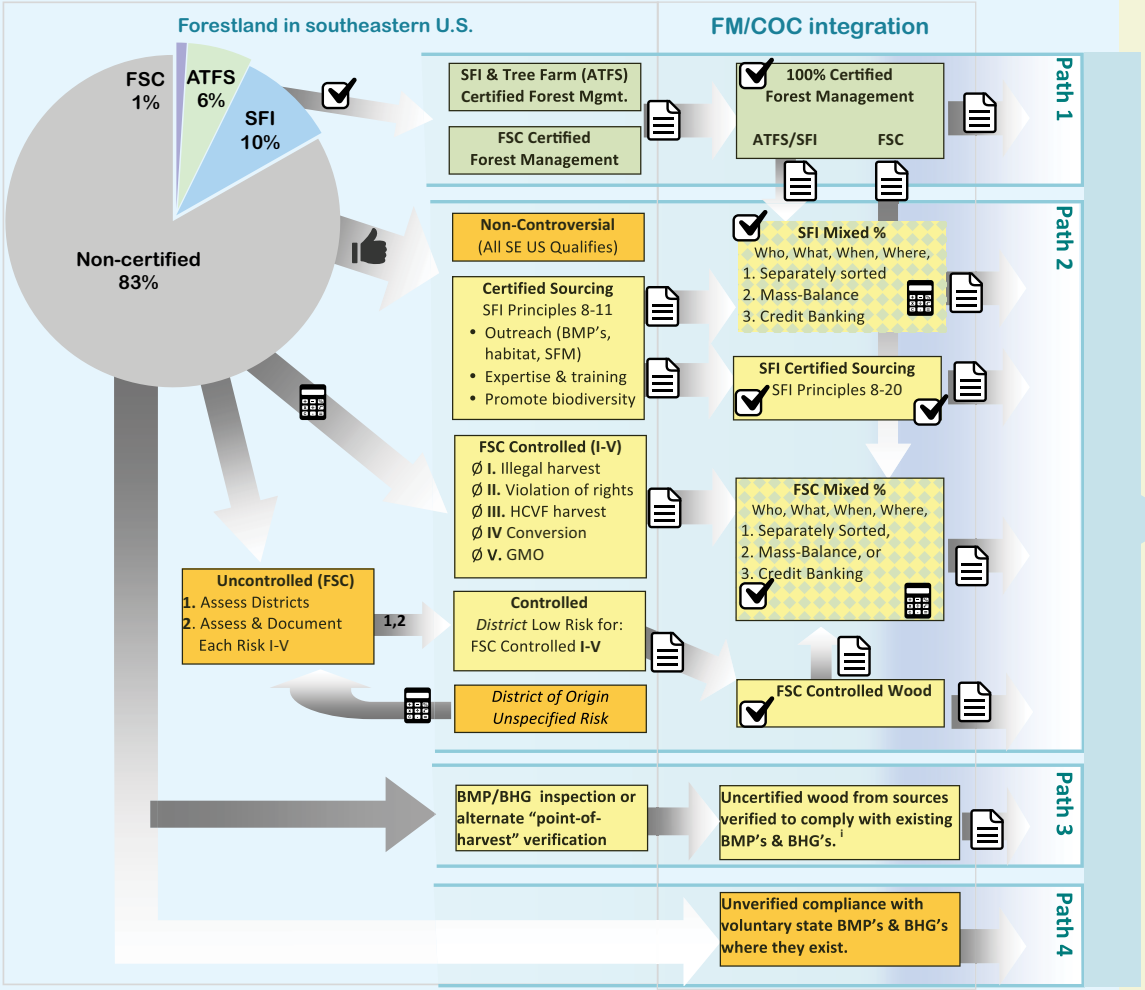
The major pathways depicted in Figure 6 each rely on different risk mitigation mechanisms along the supply chain including: standards for the production and transport of biomass, third-party verification of standard conformance, programs of outreach and training, requirements for documentation, and analysis of supply chain impacts.[42] Each available pathway includes various combinations of these sustainability mechanisms that collectively add up to be a system of supply chain risk mitigation. The pathways depicted as having the lowest risk (the pathways color-coded green) tend to rely more heavily on third-party verification of standard conformance, although this procedure is also used in other approaches.

1. Certified forest management

As depicted in the central section of Figure 6, existing forest management certification initiatives adopted by U.S. companies can meet most of the existing EU standards (the pathway 1 color-coded green). To the extent that the EU RED and country-level requirements will demand low risk procurement strategies for issues addressed in stated sustainability criteria, certification of supplies appears to be the most sound strategy currently available. Still, ATFS, FSC, and SFI forest management certification do not satisfy all of the European requirements, and do not address GHG lifecycle emissions reduction calculations or related provisions to exclude lands

FIGURE 6

Wood biomass production and sustainability claims for export from southeastern U.S.



Denotes point of 3rd party audit

Program of outreach/training

Required documentation

Analysis/assessment

Certified & Uncertified Sources in the Southeastern U.S. The majority (83%) of the forestlands in this region are not certified to the forest management standards of the ATFS, FSC, or SFI systems. However a large portion of the wood fiber from these forests can be sold as a portion of certified product through FSC requirements on controlled wood, and SFI requirements on certified sourcing. Both systems employ detailed procedures and documentation requirements to assign responsibility for tracking the origin of raw materials. The two major systems (FSC & SFI) suitable for the export of certified wood products differ in the scope of their requirements applied to all sources of fiber. [i]Denotes system of verification no yet in practice.

European Requirements for Pellets

EU Renewable Energy Directive Requirements 2009/28/EC	NTA 8080	Green Gold	Laborelec	SWAN	SE US Sources	SE US Sources	SE US Sources
Emission reduction >50%	A	A	P	P			
GHG Method Defined	A	A	A	A			
Exclude ↑carbon stock lands	A	P	N	A	R[1]		
Exclude ↑ biodiversity lands	A	P	N	A		R[2]	R[2]
Exclude biodiverse forests with ↓ human intervention	A	A	N	A			
Exclusion of wetlands and continuously forested areas	A	P	N	A		R[2]	
Exclusion of dedicated nature reserves (post 2008)	A	P	N	A			
Exclusion of Peat Lands. New draining prohibited	A	N	N	P	R[3]		
Integrated pest management. Reduced chemical use	A	A	N	P			
Soil impacts (EC reporting)	E	A	P	P		R[2]	R[2]
Water impacts (EC reporting)	E	A	P	P			R[2]
Air Impacts (EC reporting)	E	N	P	E			
Social Impacts (EC Reporting)	E	P	N	A			R[2]
Additional Requirements in National Schemes (not EU RED)							
Certification required	P	P	N	A			
Biomass harvesting/cultivation cannot convert natural forests				A	*FSC*		
Reserves specify HCV forests	A			A	*FSC*	*FSC*	

European pellet requirements based on EU guidance established for national systems by the EU Renewable Energy Directive (RED). Ratings evaluate how well national systems address RED criteria: **E**=exceed, **A**=Address, **P**=partially address (non-specific or incomplete criteria), and **N**=Not Addressed (or undefined at this date). Similarly, color-coding denotes which of different sources of wood products from the U.S. Southeast (in adjacent diagram) address each criterion. **"R"** denotes potential risk that criterion is not addressed "on-the-ground." *FSC* or *SFI* signifies when criterion is addressed by one of these systems. Notes on **"R"** are as follows: [1.] High carbon stock lands not specifically addressed, unless consistent with HCV, FECV, or other reserve designations. [2.] C&I included but not traced/evaluated on the ground. [3] Draining of peat/wetland areas unlikely, but in some cases not prohibited.

high in carbon stocks—unless these lands are designated as high conservation value forests (HCV, addressed by FSC) or forests of exceptional conservation value (FECV, addressed by SFI). However, forest management certification does provide assurance on the ground that many of the European requirements are addressed, while also requiring conformance with otherwise voluntary BMPs, and where present, biomass harvesting guidelines (so far only in Kentucky).

There are some important differences in the FSC and SFI forest management standards relative to EU RED and the EU country-level standards. Perhaps the most notable of these is the prohibition of forest-type conversion in the FSC standard. The significance of this difference depends on whether increased demand on southeastern wood supplies will over time induce conversion of natural forests; or, in conjunction with other pressures, intensifies removals to a degree that facilitates forest conversion.

Another factor worth some consideration is that some European countries certify predominantly with FSC (the UK, the Netherlands, Sweden, and several Baltic states) while others certify predominantly with PEFC (e.g., Austria, Finland, Belgium, Denmark, Germany), so that while buyers may be talking about certification, their expectations can vary widely. This may have some bearing on which forest management certification systems are preferred by energy companies operating in each of these countries (Martikainen and Van Dam 2010). The effect of this, if any, on the procurement strategies of pellet mills in the U.S., remains unclear.

2. Controlled and mixed sourcing

The procurement approaches of these forest certification systems (i.e., the pathways depicted in the top five boxes color-coded yellow)—specifically the procedures used to certify materials that do not originate from lands that are actually certified[43]—less reliably show conformance with EU standards but are useful to control risks and promote better forest management practices. Materials procured through SFI Fiber Sourcing and mixed with material from an SFI/ATFS-certified forest (SFI mixed or CoC) require an audit to a reduced portion of the standard most appropriate for smaller landowners. The same is true for material labeled with SFI's certified-sourcing label. The SFI and through endorsement, PEFC, require that companies selling these materials maintain a program of promotion and outreach to ensure that an essential suite of sustainable forest management practices are implemented.[44] These include:

Objective 8. Landowner outreach. To broaden the practice of sustainable forestry by forest landowners through Fiber Sourcing programs.

Objective 9. Use of qualified resource and qualified logging professionals.

Objective 10. Adherence to best management practices.

Objective 11. Promote conservation of biological diversity, biodiversity hotspots and high-biodiversity wilderness areas.

Similarly, materials procured through the FSC Controlled Wood standard and mixed with fiber from FSC certified forests are subject to a reduced subset of the FSC forest management standard, aimed principally at controlling certain risks. FSC products cannot include any materials that are determined to be an unspecified risk for the following issues.[45]

- illegally harvested wood
- wood harvested in violation of traditional and civil rights
- wood harvested in forests where high conservation values are threatened by management activities
- wood harvested in forests being converted to plantations or non-forest use
- wood from forests in which genetically modified trees are planted

For reasons discussed elsewhere in this report—mainly owing to the limited acreage of certified forest management under any system—the bulk of the certified wood pellets and chips available for export will be delivered through these chain-of-custody systems. Despite the narrower scope of assurances traced to the ground, the CoC approaches common to SFI's Fiber Sourcing and FSC's Controlled Wood systems are globally accepted means to address the difficulties of mixed sourcing and the relatively limited extent of certified forest management. The procedures through which the two systems require documentation and tracking of constituent materials is similar and rigorous enough to directly articulate with the CoC requirements associated with European sustainability standards. They include requirements on documentation, tracking, sorting, and calculations for displaying certified content by source.

Both systems also include relatively similar accounting options for recording and reporting certified content over the course of a year. The batch crediting, or certified credit banking system, may be particularly useful to pellet and chip producers faced with several distinct local and overseas markets demanding different sustainability claims. In this system, producers using similar or substitutable inputs for raw materials may "bank" credits for the certified portion. Accumulated credits can then be transferred to different batches, such that they can be sold with a higher certified content than would be included in each batch or run. This approach allows pellet producers to schedule future shipments of higher certified content pellets and service multiple market end points. Other labeling options are based on separate sorting, and percentage-based claims.

The two systems differ in the way in which they deal with fiber of uncertain or risky provenance. SFI has a "Non-Controversial" source policy; however, it only applies to procurement from outside the U.S. and Canada. So for domestic sourcing, whatever portion is not included in the certified sourcing program can be readily mixed with other qualified certified materials (sourcing, forest management, recycled, etc.) up to one-third by weight or manufacturing unit—with up to two-thirds of the material being non-certified and accepted under the Fiber Sourcing standard described above.

The procurement systems for pulp and paper are well established and have been proven to work with existing certification programs.

FSC requires that all content must not originate from "districts with unspecified risks." The risks are the same concerns addressed in the FSC Controlled Wood standard (I-V). Companies are required to carry out a risk assessment for their procurement, and should they find one of the considerations (i.e., I-V) to be an unspecified risk (i.e., not easily proven a "low risk" as they do not use the term "high risk"), the company is required to individually evaluate that particular risk in their supply area. In other words, the company would need to "specify" the risk. As this process of risk assessment by each company for their own supply area is prone to inconsistencies, FSC is performing a risk assessment for the U.S. (as part of a country-by-country risk assessment) that will apply to the wood pellet market. By the end of 2012, companies will be required to use the FSC risk-assessment for the US. Should there prove to be areas that are "higher risk" in the Southeast, a company would need to document these risks.

The procurement systems for pulp and paper are well established and have been proven to work with existing certification programs (FSC and PEFC). Biomass is in some ways more complex because it involves material that is of even less value and may come from more diverse sources than pulp and paper. It is likely that wood dealers and/or biomass aggregators will continue to play a significant role in the wood pellet market, especially given European demand for chain-of-custody or equivalent tracking of the supply chain.

3. Uninspected forest operations

Pellet products and wood chips received from non-certified sources or sourcing systems provide less assurance of conformance with EU RED and country-level requirements. Their sustainability is solely dependent on widespread and consistent implementation of the voluntary guidance (BMPs) and related regulatory and non-regulatory approaches issued by state and local governments. As discussed in prior sections of the report, the scope of issues covered by each state differs, and BMP implementation is variable. For example, only the few landowners

using management plans in any state in the region are likely to have inquired about species occurrences and rare habitats.

Represented in the bottom section of Figure 6, and color-coded orange, this pathway consists of virtually no investments in controlling the source of wood supply by a given buyer—a pellet mill or end user in Europe. This pathway relies only on the regulatory and non-regulatory measures present in each state (see review of BMPs and other programs in section 4 below). Among requirements included in the EU RED framework, BMPs and BHGs (i.e., Kentucky) may not address: emissions, forest conversion, preferences for integrated pest management or reduced chemical use, and the exclusion of biodiverse forests. Some of these will surely be addressed or are non-issues. Some may also be addressed through calculations performed by the producer, exporter, and destination energy facility. Others such as social impacts (e.g., wages and workers rights) are covered by state and federal statutes. Nevertheless, as previously stated BMPs are largely voluntary, and being new, no data yet exists on the rate of adoption and effectiveness of BHGs. Overall, purchasing biomass through this pathway is a higher risk procurement strategy, although the risks inherent in this pathway can be reduced by installing measures to verify and/or elevate compliance with BMPs and related programs.

4. Inspected compliance for plans and practices

Corporate or industry-level sourcing programs can strengthen conformance with plans and practices through programs of training and inspection. There are a number of models of this kind, not the least of which is the SFI program, which requires the use of qualified logging professionals. Companies could add to this harvest-based inspections that interface directly with logging contractors to verify conformance with BMPs. They could also include logger certification and training programs in the use of biomass harvesting guidelines, such as the Forest Guild's southeast regional guidelines. These options are described below and illustrated in the case study in Georgia below.

CASE STUDY Pathways approach applied in Georgia

Georgia Biomass, LLC, a subsidiary of RWE—a large European renewable energy corporation, opened its Waycross, Georgia (USA) facility in May of 2011. This facility makes two major claims related to sourcing: (1) It sources 54% (810,000 tons) of its total fiber from PEFC (SFI ATFS) certified forests, and (2) 100% of its fiber is procured using the SFI Fiber Sourcing and FSC Controlled Wood standards. Like all facilities selling to the European market Georgia Biomass works with its buyers to address the main variables in the EU Report COM(2010)11, calculating the GHG lifecycle of the energy system, and tracing feedstocks to verify their source.

While Georgia Biomass has taken strides to source sustainably, it will have to make some strategic sourcing decisions regarding the 46% of its fiber not sourced from certified forests.

One option, the facility could consider leveraging the SFI and ATFS programs in its sourcing area by augmenting the existing master logger training program. There are 651 registered master loggers within a 75 mile radius around the Waycross plant. These individuals participate in training programs that teach the basics of BMP implementation, silviculture, regulatory compliance, and other important issues, that may even include biomass harvest and retention practices.

Another option could include the development of a point of harvest certification program whereby participating loggers in its supply area agree to have their logging operations open for auditing by a third party. Loggers would participate in the training, follow biomass harvesting guidelines, and agree to have their harvests open to third-party auditors. The facility would cover the cost of the audits and possibly the augmentation of applicable training programs to teach about biomass harvest and retention practices.

This might take the form of a simple extension of existing master logger training programs or be developed into a more robust point of harvest certification program such as the Smart Logging certification program of the Rainforest Alliance. In point of harvest certification, participating loggers agree to follow a standard against which their performance is audited annually by having a third party evaluate a sample of their logging jobs each year. A landowner and/or wood buyer could feasibly work with a group of point of harvest certified loggers to help ensure that forests are logged responsibly.

In the South, there are 45 Smart Logging certificate holders (4 in Louisiana, 16 in Kentucky, 25 in Tennessee), 41 of which are clients of the University of Kentucky. While not full-blown forest management certification, Smart Logging certification can supplement forest management certification and address a gap in the supply chain where PEFC and/or FSC forest management, CoC, and sourcing standards are unlikely to apply. This approach was pioneered in 2003 by loggers in the Northeast who began the Trust to Conserve Northeast Forestlands. A similar approach could emerge in the South, and might be spearheaded by individual wood buyers, pellet facilities, and/or industry trade associations as a means to address the unique landscape, culture, and demographics of the South.

Another similar approach that southern pellet mills might consider is borrowing procurement systems of bioenergy facilities elsewhere in the U.S. In Gainesville, Florida, a biopower company will see a higher rate of return on the sale of its electricity if it is able to document that its biomass supply is sourced in a manner that protects certain forest values. Specifically, the Gainesville Regional Utility will reward landowners with a $0.50 or $1.00/ton premium if they are in the Florida Forest Stewardship Program or certified under the FSC forest management standard, respectively. The McNeil generating station in Burlington, Vermont, uses a multi-faceted wood procurement standard. The facility employs a professional forester to monitor each harvest, ensuring adherence to a sustainable management standards. Each of these planned harvests must also be approved by the Vermont Department of Fish and Wildlife.

Current signals from buyers in Europe, the EU and regulators in each country, indicate that demand will be associated with concern for sustainability and emissions accounting.

If pellet mills were to borrow from the McNeil generating station model and hire consulting foresters to oversee harvests, the facility could encourage FSC group certification under its forester. This would allow the facility to increase the amount of FSC certified material in its supply chain, which might allow it to diversify its product line. Even if the amount of FSC certified pellets is small, the FSC crediting system would allow for 100% FSC shipments to be made to customers in Europe on a periodic basis.

Government programs like BCAP also may have a role to play in procurement. If BCAP is utilized in the establishment of supply chains, this might include completing the due diligence on the supply area required to meet European buyer requirements. Other Farm Bill programs and the Forest Stewardship program also play important roles in helping landowners develop a management plan and take steps toward responsible management. But these have experienced limited coverage. If facilities can incentivize sourcing from these lands, risks of unplanned harvests and harvests resulting in conversion are significantly less.

Conclusion

Strong forest product markets have long been associated with maintaining forest cover, and traditional markets in U.S. are declining. While landowners lose revenue from these sources, and with them the opportunity to reinvest in the land, the South is also expected to see continued development pressure on urban and suburban margins. Bioenergy development presents opportunities for retaining and reinvesting in working forestlands. However, current signals from buyers in Europe, the EU and regulators in each country, indicate that demand will be associated with concern for sustainability and emissions accounting.

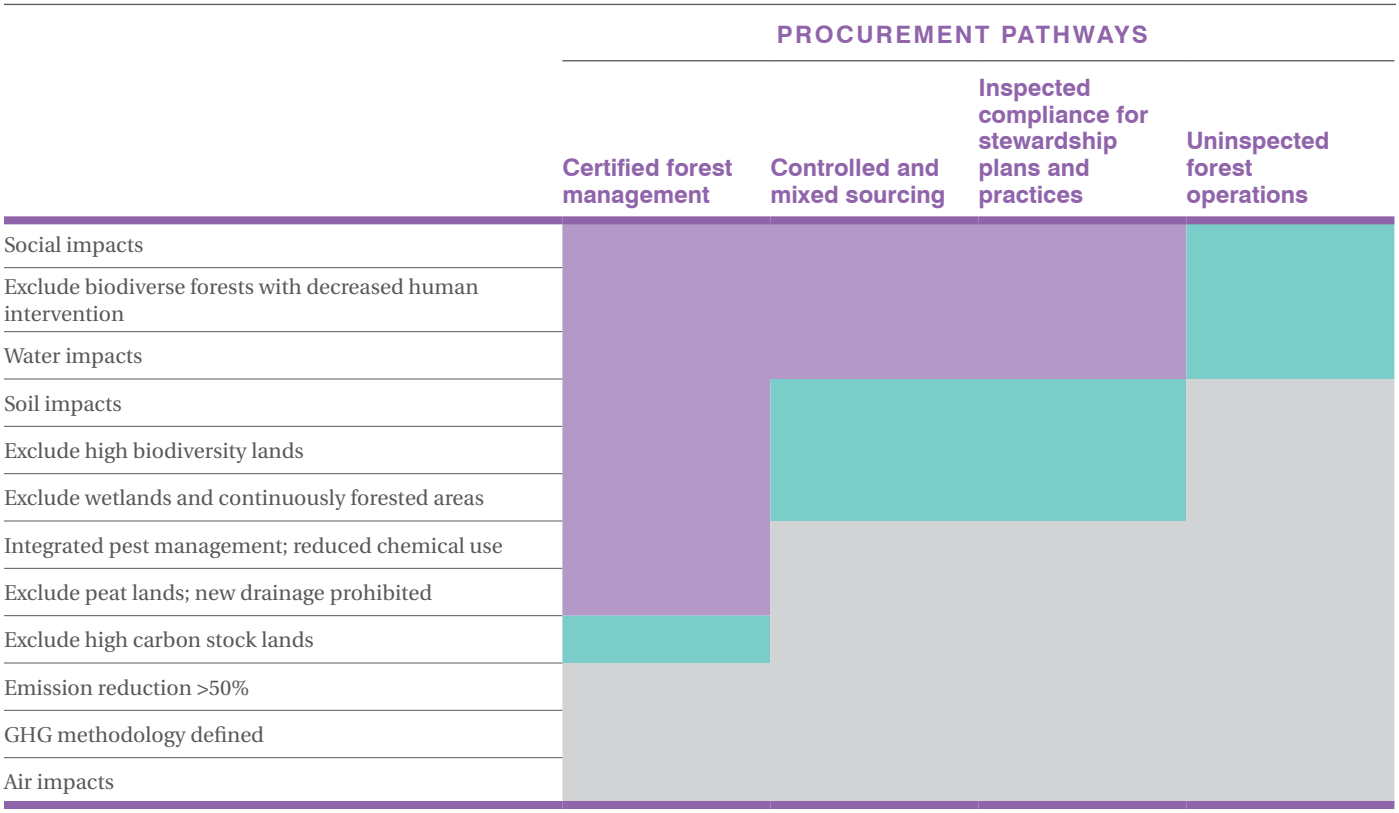
Much of the uncertainty facing the wood biomass export market will, hopefully, be resolved once the European Commission finalizes recommendations for EU-level sustainability criteria

and the ISO standards for wood biomass sustainability certification have been established. While the evolution in European policies can complicate export strategies, the experience in Europe to date, and our decades of experience in the U.S. in sustainable sourcing, makes wise anticipation and planning possible.

Pellet producers and the various links in the supply chain can choose among a number of pathways, representing varied levels of conformance with voluntary sourcing standards developed in Europe. This report has reviewed four of these pathways that the energy industry can pursue (see below). These pathways can work together or independently, and exporters of forest biomass can select among these pathways depending on the level of risk they would like to mitigate and which sustainability claims they would like to make. A *Pathways to Sustainability* model provides a new approach to recognize the various ways landowners and biomass producers can meet their environmental objectives.

TABLE 11

EU renewable energy directive sustainability criteria



Procurement pathway *fully* addresses sustainability requirement
Procurement pathway *partially* addresses sustainability requirement
Procurement pathway does not address sustainability requirement

Notes

1 Data from Forisk Consulting.

2 China imported a record amount of woodchips (mostly hardwood) for paper production in 2011. http://www.woodprices.com/

3 Pellet producer, personal communication, March 12, 2012.

4 This would be 207,690 acres if the entire growing stock is harvested.

5 This assumes that 2 green tons wood = 1 ton wood pellets. 100 MW = 1.2 million green tons *30 cf/ton = 36 mmcf wood. 36 mmcf÷1,322 cf/acre (U.S. South) = 27,692 acres of forest if *entire growing stock* is harvested. 36 mmcf÷57 cf/acre net annual growth (U.S. South) = 631,579 acres *sustainably harvested*.

6 http://www.srs.fs.usda.gov/futures/reports/draft/Frame.htm

7 http://www.cepf-eu.org/artikkel.cfm?ID_art=480 (accessed on July 5, 2012).

8 This strategy is increasingly favored because it may reduce the risk of supply chain disruptions. These entities are a bridge between the biomass producers (i.e., loggers, haulers, and aggregators) and the biomass facility (Altman and Johnson 2009). Approximately 11% of existing biopower facilities in the U.S. rely strictly on external procurement entities (e.g., wood dealers or biomass aggregators) whose job it is to coordinate supply chain logistics.

9 This price point is specific to biopower facilities in the coastal plain of North Carolina and is based on a personal conversation with Marvin Burchfield, Decker Energy International August 26, 2009.

10 For additional explanation see (Joudrey 2012).

11 http://www.hvnplus.co.uk/news/first-meet-for-biomass-parliamentary-group/8627959.article

12 http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/FuelledStations/bbcc/Pages/bbcc.aspx

13 G. Jones, personal communication, November 14, 2011.

14 http://www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=598379 (accessed on July 5, 2012).

15 These include ISO 62, 65, 66, and 19011.

16 http://isotc.iso.org/livelink/livelink?func=ll&objId=8931012&objAction=browse (accessed on July 5, 2012).

17 The next meeting of ISO TC 248 was in Chicago, from April 16–20, 2012 and a timeline for a defined standard is not publicly available.

18 Among other sources, our review of sustainability criteria included Martikainen and Van Dam 2010; Alakangas 2011; Van Dam, Junginger and Faaij 2010; Lal et al. In Press; Lattimore et al. In Press; Evans, Perschel and Kittler 2010; Vis, Vos and Van den Berg 2008; GBEP 2011; and the Montreal Process Criteria and Indicators.

19 http://www.greengoldcertified.org/site/pagina.php?id=51 (accessed on July 5, 2012).

20 http://certification.controlunion.com/ (accessed on July 5, 2012).

21 Mass balance calculations derive the amount of physical mixing of certified and non-certified biomass in a given batch of biomass. Under this system the percentage of biomass sold as certified is calculated to be the percentage of certified material entering the production chain.

22 http://www.bioenergytrade.org/downloads/roryckmans.pdf. Additional information can be fund at http://www.laborelec.be/ENG/wp-content/uploads/PDF/101118_-_Ryckmans_-_Sustainability_scheme_solid_biomass.pdf (accessed on July 5, 2012).

23 http://www.enplus-pellets.eu/pellcert/ (accessed on July 5, 2012).

24 http://www.draxpower.com/biomass/sustainability_policy/ (accessed on July 5, 2012).

25 http://www.sustainable-biomass.org/ (accessed on July 5, 2012).

26 http://www.sustainable-biomass.org/dynamics/modules/SFIL0100/view.php?fil_Id=1094 (accessed on July 5, 2012).

27 http://www.sustainable-biomass.org/dynamics/modules/SFIL0100/view.php?fil_Id=1094 (accessed on July 5, 2012).

28 http://www.nordic-ecolabel.org/criteria/product-groups/ (accessed on July 5, 2012).

29 www.fscus.org (accessed on July 5, 2012).

30 http://www.fsc.org/cw.html (accessed on July 5, 2012).

31 www.sfiprogram.org (accessed on July 5, 2012).

32 SFI 2010-2014 Standard is available here: http://www.sfiprogram.org/files/pdf/Section2_sfi_requirements_2010–2014.pdf; a detailed interpretation of the SFI standard is available here: http://www.sfiprogram.org/files/pdf/Interpretations_2010-2014_Requirements.pdf (accessed on July 5, 2012).

[33] www.treefarmsystem.org; a database of ATFS certificates is available from: http://www.treefarmsystem.org/atfsverificationdatabase (accessed on July 5, 2012).

[34] www.csbp.org (accessed on July 5, 2012).

[35] As of 2000, a total of 346 forest-related local ordinances had been enacted in 10 Southern states (Wear 2002).

[36] The categories of BMPs evaluated include: harvesting, site preparation, forest roads, stream crossings, streamside management zones, firebreaks, and chemical application.

[37] http://www.forestguild.org/biomass.html (accessed on July 5, 2012).

[38] The best guidelines also offer detailed ways in which nutrient poor sites can be identified.

[39] http://www.fsa.usda.gov/FSA/webapp?area=home&subject=ener&topic=bcap&utm_source=spotlight&utm_medium=click&utm_content=rotation2&utm_campaign=bcapeducation (accessed on July 5, 2012).

[40] The EA must be consistent with the regulations at 40 CFR § 1501.4(c).

[41] Figures 4 and 5 adapted from S. M. Stein, M. A. Carr, R. E. McRoberts, L. G. Mahal; and S. J. Comas. Threats to at-risk species in America's Private Forests: A Forests on the Edge Report. USDA Forest Service General Technical Report. NRS-73. October 2010.

[42] In Figure 6 risk mitigation checkpoints are identified using icons.

[43] Namely the SFI Fiber Sourcing standard and the FSC Controlled Wood standard.

[44] Objectives 8-13 from the SFI Standard. This subset of the Objectives (which are supported by Performance Measures and indicators) are those that most directly effect source-forests, and are typically met through promotional, outreach and training activities initiated by a company. These programs and the means by which companies preferentially select contractors are evaluated in an SFI chain-of-custody audit. The standard is posted at www.sfiprogram.org/sustainable_forestry_initiative_standard.php (accessed on July 5, 2012).

[45] FSC standard for company evaluation of FSC Controlled Wood, FSC-STD-40-005 (V2-1) EN.

Appendices

Appendix 1: Comparison of EU-level sustainability criteria for liquid biofuels with various voluntary schemes

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APPENDIX 1

Comparison of EU-level sustainability criteria for liquid biofuels with various voluntary schemes

Criteria of EU Renewable Energy Directive Requirement Directive 2009/28/EC	NTA 8080 (Netherlands)	Green Gold (Essent, Netherlands)	Laborelec Certification System (Belgium)	SWAN Label (Nordic Countries)	FSC	PEFC	SFI	ATFS
At least 50% GHG emission reduction compared to fossil fuels	Principle included that meets EU RED. Specific C&I defined.	Principle included and meets EU RED. (see GGLS8) Specific C&I identified.	Principle is included and does not yet meet EU RED. Criteria and indicator not present.	Principle included that does not meet EU RED. Principle is dependent on reference case in which emissions must not exceed 50 g CO_2 eq/MJ f\fuel. Specific C&I are defined.	Principles not included that meet EU RED. Specific C&I are not identified.	Principles not included that meet EU RED. Specific C&I are not identified.	Principles not included that meet EU RED. Specific C&I are not identified.	Principles not included that meet EU RED. Specific C&I are not identified.
GHG methodology defined in standard	Principle included that meets EU RED.	A GHG LCA accounting methodology is defined.	A GHG LCA accounting methodology is defined.	Yes, the specific methodologies are defined according to EU RED specifications.	Principles not included that meet EU RED. Specific C&I are not identified.	Principles not included that meet EU RED. Specific C&I are not identified.	Principles not included that meet EU RED. Specific C&I are not identified.	Principles not included that meet EU RED. Specific C&I are not identified.
Exclusion of lands with high carbon stock that have recently been converted	Principle included that meets EU RED. Specific C&I defined.	Principle included and does not meet EU RED. Specific C&I are not identified. Although some guidance is given, clear criteria and indicators are considered to be missing.	Not yet defined.	Principle included and meets the EU RED. Biomass must not be cultivated on land that binds up large quantities of carbon. If the cultivation of biomass has resulted in a change in land use since November 2005, any emissions of carbon must be repaid, using the fuel in question, within a period of no more than 20 years. Specific C&I are included.	Principles included that do not meet EU RED. Specific C&I identified. A forest carbon working group was established in 2009 (outcome).	Principles included that do not meet EU RED. Specific C&I identified. ITTO: Total amount of carbon stored has to be documented.	Principles included that do not meet EU RED. Specific C&I identified. Under SFI this condition is only met if recognized under local, federal or (inter-) national laws and regulations.	Principles included that do not meet EU RED. Specific C&I identified.

Criteria of EU Renewable Energy Directive Requirement Directive 2009/28/EC	NTA 8080 (Netherlands)	Green Gold (Essent, Netherlands)	Laborelec Certification System (Belgium)	SWAN Label (Nordic Countries)	FSC	PEFC	SFI	ATFS
Exclusion of lands with high biodiversity value	Principle included that meets EU RED. Specific C&I defined. HCV areas are to be identified in consultation with stakeholders.	Principle included that meets EU RED. Specific C&I are not identified. Although some guidance is given, clear criteria and indicators are considered to be missing. Plantations are not established by converting a forest and should promote the restoration and conservation of natural forests. Other sources than natural forests and plantations must not contain HCV areas.	Not yet defined.	Principle meets EU RED. Specific C&I defined. Requires that the raw material does not originate in areas in which biodiversity or values worthy of protection for social reasons are under threat. Not further defined.	Principles meet EU RED. Specific C&I identified. Plantations established in areas converted from natural forests after November 1994 normally shall not qualify for certification. Forest conversion to plantations or non-forestland uses shall not occur, except in specified circumstances and conservation of High Conservation Value Forests. If falling under national legislation or international agreements as CITES and CBD.	Principles included that meet EU RED. Specific C&I are not identified.	Principles meet EU RED. Specific C&I identified. Promotion of conservation of native biological diversity. Recognition of local, federal and (inter-) national laws is required including (for U.S. and Canada) Ramsar convention. Special sites (ecologically, culturally) are protected and conserved but not explicitly excluded.	Principles included that do not meet EU RED. Specific C&I identified. The standard mentions that "Where practicable, management plans consider and address opportunities to protect rare species and special habitat features and sites of special interest must be recognized." Only if protected under local, federal or national law
Exclusion of wetlands and continuously forested areas	Principle included that meets EU RED. Specific C&I defined. Wetlands, continuously forested areas and peat land considered as an area with high risk of carbon soil losses.	Principle included that meets EU RED. Specific C&I are not identified. Although some guidance is given, clear criteria and indicators are considered to be missing. Plantations are not established by converting a forest and should promote the restoration and conservation of natural forests. Other sources than natural forests and plantations must not contain HCV areas.	Not yet defined.	Principle meets EU RED. Specific C&I defined.	Principles meet EU RED. Specific C&I identified. Plantations established in areas converted from natural forests after November 1994 normally shall not qualify for certification.	Principles included that meet EU RED. Specific C&I are not identified.	EU RED. Specific C&I identified. Promotion of conservation of native biological diversity. Recognition of local, federal and international laws is required including (for U.S. and Canada) Ramsar convention. Special sites (ecologically, culturally) are protected and conserved but not explicitly excluded.	Principles included that meet EU RED. Specific C&I identified.

Criteria of EU Renewable Energy Directive Requirement Directive 2009/28/EC	NTA 8080 (Netherlands)	Green Gold (Essent, Netherlands)	Laborelec Certification System (Belgium)	SWAN Label (Nordic Countries)	FSC	PEFC	SFI	ATFS
Exclusion of lands designated for nature purposes as of January 2008	Principle included that meets EU RED. Specific C&I defined.	Principles included that do not meet EU RED. Specific C&I are not identified. This only applies if the stakeholder consultation identifies such lands.	Not yet defined.	Principle meets EU RED. Specific C&I defined.	Principles meet EU RED. Specific C&I identified. Plantations established in areas converted from natural forests after November 1994 normally shall not qualify for certification.	Principles included that meet EU RED. Specific C&I are not identified.	EU RED. Specific C&I identified. Promotion of conservation of native biological diversity. Recognition of local, federal and (inter-) national laws is required including (for U.S. and Canada) Ramsar convention. Special sites (ecologically, culturally) are protected and conserved but not explicitly excluded.	Principles meet EU RED. Specific C&I are defined.
Exclusion of biodiverse forest with no significant human intervention	Principle included that meets EU RED. Specific C&I defined. HCV areas are to be identified in consultation with stakeholders.	Principle is included and meets EU RED. Specific C&I identified.	Not yet defined.	Principle meets EU RED. Specific C&I defined.	Principles meet EU RED. Specific C&I identified. Forest conversion to plantations or non-forestland uses shall not occur, except in specified circumstances and conservation of High Conservation Value Forests. If falling under national legislation or international agreements as CITES and CBD.	Principles included that meet EU RED. Specific C&I are not identified.	EU RED. Specific C&I identified. Promotion of conservation of native biological diversity. Recognition of local, federal and (inter-) national laws is required including (for U.S. and Canada) Ramsar convention. Special sites (ecologically, culturally) are protected and conserved but not explicitly excluded.	Principles meet EU RED. Specific C&I are defined. The standard mentions that "Where practicable, management plans consider and address opportunities to protect rare species and special habitat features and sites of special interest must be recognized."
Exclusion of high biodiverse grasslands	Principle included that meets EU RED. Specific C&I defined. Wetlands, continuously forested areas and peat land considered as an area with high risk of carbon soil losses.	Principle included that does not meet EU RED. Specific C&I are not identified.	Not yet defined.	Principle meets EU RED. Specific C&I defined.	Principle included that does not meet EU RED. Specific C&I identified.	Principles included do not meet EU RED. Specific C&I are not identified.	Principles included that do not meet EU RED, unless identified in local, state, or national laws. Specific C&I are not identified.	Principles included that do not meet EU RED. Specific C&I included.

Criteria of EU Renewable Energy Directive Requirement Directive 2009/28/EC	NTA 8080 (Netherlands)	Green Gold (Essent, Netherlands)	Laborelec Certification System (Belgium)	SWAN Label (Nordic Countries)	FSC	PEFC	SFI	ATFS
Exclusion of peat land unless proven that draining of previously undrained soil is not involved	Principle included that meets EU RED. Specific C&I defined. Wetlands, continuously forested areas and peat land considered as an area with high risk of carbon soil losses.	Principles are not included that meet the EU RED. Specific C&I are not identified.	Not yet defined.	Principle meets EU RED. Specific C&I defined.	Principle included that does not meet EU RED. Specific C&I identified.	Principles included do not meet EU RED. Specific C&I are not identified.	Principles included that do not meet EU RED, unless identified in local, state, or national laws. Specific C&I are not identified.	Principles included that do not meet EU RED. Specific C&I included.
Condition of good agricultural practice: Integrated pest management techniques; chemicals	Principle for integrated pest management included that meets EU RED. Specific C&I defined. Principle for chemicals that exceeds EU RED. Specific C&I Identified. Measures have to be taken to avoid disruption of environment by use of agrochemicals	Principles included that meet EU RED. Specific C&I included.	Not yet defined.	Principle included that does not meet EU RED. C&I defined. Raw materials used in the production of the fuel must be certified in accordance with a specified standard and certification system (which might fulfill these requirements).	Principles included that exceed EU RED. Specific C&I identified. Integrated pest management shall form an essential part of the management plan for plantations.	Principles for integrated pest management are not included, while principles for chemicals exceed those of the EU RED. Specific C&I are included.	Principles exceed EU RED. Specific C&I identified. Use of integrated pest management where feasible. Minimized chemical use is recommended.	Principles exceed EU RED. Specific C&I included.
Reporting obligation to the EC on soil impacts in regions that are significant source of feedstock	Principles exceed EU RED. Specific C&I identified.	Principles included that meet EU RED. Specific C&I included.	Mentioned. Criteria and indicators not present.	Principle included that does not meet EU RED. C&I defined. Raw materials used in the production of the fuel must be certified in accordance with a specified standard and certification system (which might fulfill these requirements).	Principles included that exceed EU RED. Specific C&I identified. Conversion of soil and water resources. Monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts including effects on water resources and soil fertility, and impacts on local welfare and social well-being.	Principles included that exceed EU RED. Specific C&I identified. Conversion of soil and water resources. Monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts including effects on water resources and soil fertility, and impacts on local welfare and social well-being.	Principles exceed EU RED. Specific C&I identified. Management practices to maintain and restore the soil. Data are collected.	Principles included that do not meet EU RED. Specific C&I are not yet identified. Standard mentions that forestry practices maintain or enhance the environment, including air, water, soil, and site quality. Management according to State Best Management Practices (BMP).

Criteria of EU Renewable Energy Directive Requirement Directive 2009/28/EC	NTA 8080 (Netherlands)	Green Gold (Essent, Netherlands)	Laborelec Certification System (Belgium)	SWAN Label (Nordic Countries)	FSC	PEFC	SFI	ATFS
Reporting obligation to the EC on water impacts in regions that are significant source of feedstock	Principles exceed EU RED. Specific C&I identified.	Principles included that meet EU RED. Specific C&I included.	Mentioned. Criteria and indicators not present.	Principle included that does not meet EU RED. C&I defined. Raw materials used in the production of the fuel must be certified in accordance with a specified standard and certification system (which might fulfill these requirements).	Principles included that exceed EU RED. Specific C&I identified. Conversion of soil and water resources. Monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts including effects on water resources and soil fertility, and impacts on local welfare and social well-being.	Principles included that exceed EU RED. Specific C&I identified. Conversion of soil and water resources. Monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts including effects on water resources and soil fertility, and impacts on local welfare and social well-being.	Principles meet EU RED. Specific C&I identified. Fulfillment of local, federal and national laws and development of riparian protection measures (mapping of streams and water bodies, data on water quality not specified).	Principles exceed EU RED. Specific C&I included. Management according to State Best Management Practices (BMP). Landowner must minimize disturbances with riparian zones. Details on data requirement are limited.
Reporting obligation to the EC on air impacts in regions that are significant source of feedstock	Principles exceed EU RED. Specific C&I identified.	Principles not included. Specific C&I are not identified.	Mentioned. Criteria and indicators not present.	Principle included that does not meet EU RED. C&I defined. Raw materials used in the production of the fuel must be certified in accordance with a specified standard and certification system (which might fulfill these requirements).	Principles included that do not meet EU RED. Specific C&I Identified.	Principles included that do not meet EU RED. Specific C&I identified.	Principles included do not meet EU RED. Specific C&I are not identified. Minimization of waste is required and conservation of air resources mentioned in principles.	Principles included do not meet EU RED. Specific C&I are not identified.
Reporting obligation to the EC on social impacts in regions that are significant source of feedstock: Child labor, wages, freedom of unions / association, land use rights	Principles exceed EU RED. Specific C&I identified.	Principles are included that included socioeconomic descriptions that meet EU RED up to a point. Land use rights exceed EU RED, while principles for child labor, wages, and unions are not included. Specific C&I are identified in some instances.	Criteria and indicators not defined.	Principles included that go beyond the EU RED. Specific C&I defined.	Principles exceed EU RED. Specific C&I identified. Monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts including effects on water resources and soil fertility, and impacts on local welfare and social well-being. International conventions as ILO are binding.	Principles meet or exceed EU RED. Specific C&I identified. Principles for child labor, wages, and unions meet EU RED, while principles for land rights exceed EU RED.	Principles meet EU RED. Specific C&I identified. National labor laws cover the identified topics on social impacts. Written policy required to comply with social laws.	Principles included that do not fully meet EU RED. As fulfillment of national laws is required, indicated social impacts are fulfilled. Overall, some C&I have yet to be identified. Principles are adequate for child labor, wages, unions, and land use rights, and C&I are identified for these as well.

Criteria of EU Renewable Energy Directive Requirement Directive 2009/28/EC	NTA 8080 (Netherlands)	Green Gold (Essent, Netherlands)	Laborelec Certification System (Belgium)	SWAN Label (Nordic Countries)	FSC	PEFC	SFI	ATFS
Extra principles and/or criteria are included not indicated in list above: compliance of local and national laws, social and/or environmental impact assessment	Principles included but do not meet EU RED. Specific C&I are included.			Principles included that go beyond the EU RED. Specific C&I defined.	Principles exceed EU RED. Specific C&I identified.	Principles exceed EU RED and specific C&I are identified.	Principles exceed EU RED for compliance with local and national laws and specific C&I are identified. However, there are no specific requirement on collection socio-economic data or environmental impact assessment that meet the EU RED.	Principles for compliance with local and national laws exceed EU RED and specific C&I are identified. Yet, social and/or environmental impact assessments are not included, meaning that this principle is inadequate for the EU RED.

Source: Vis, Vos and Van den Berg 2008

APPENDIX 2

Comparison of criteria for sustainable forest management with various voluntary schemes

Criteria		EC-RED Requirement Directive 2009/28/ EC (liquid fuels)	Report COM (2010)11 (Guidance for member states on solid biomass criteria)	DRAX (UK)	NTA 8080 (Netherlands)	Green Gold Label (Essent, Netherlands)	Laborelec System (Belgium)
1	**Conservation of Biological Diversity**						
1.1	Species Diversity	1	1	2	1	1	—
1.1.1	Important Species (i.e., state natural heritage) Identified in a Forest Management Plan	1	1	2	1	•	—
1.2	Provisions for Genetic Diversity	—	—	—	—	—	—
1.3	Important Wildlife Habitat Across Landscape	1	1	2	1	1	—
1.4	Important Wildlife Habitat at the Stand Level	—	—	—	—	—	—
1.5	Amount and Distribution of Organic Matter Present on Forest Floor	—	—	—	•	—	—
1.6	Ecological Reserves/Special Area/Protected Areas	3	—	2	•	•	—
1.7	Rare forest types (e.g., Old Growth)	4	1	2	1	•	—
1.8	Riparian & Aquatic System Biological Resources	1	1	2	1	1	—
2	**Maintenance of Productive Capacity of Forest Ecosystems**						
2.1	Ecological Function/Maintenance of Forest Nutrient Capital over the Long-term	—	—	—	—	—	—
2.2	Landscape-Scale Spatial Patterns (e.g., Fragmentation and Connectivity)	—	—	—	—	—	—
2.3	Representation of Regionally Appropriate Forests and Structural Diversity	—	—	—	—	—	—
2.4	Retention of Deadwood (Coarse Woody Debris, Fine Woody Debris, Snags)	—	—	—	•	—	—
3	**Maintenance of Forest Ecosystem Health and Vitality**						
3.1	Forest Protection/Health: Fire	—	—	—	—	—	—
3.2	Forest Protection/Health: Exotic Species/ Noxious Weeds	—	—	—	—	—	—
3.3	Forest Protection/Health: Pests and Pathogens	—	—	—	—	—	—
3.4	Forest Protection/Health: Hazardous Materials/Debris/ Waste	—	—	—	—	—	—
3.5	Harvest Operations and Access: Forest Roads	—	—	—	—	•	—
3.5	Vehicles and Machinery Used in Harvest Should Cause Minimal Damage to Ecosystem	—	—	—	—	•	—
4	**Conservation and maintenance of Soil and Water Resources**						
4.1	Resource Conservation: Water Yield and Water Quality	•	—	•	—	•	•

Criteria		EC-RED Requirement Directive 2009/28/EC (liquid fuels)	Report COM (2010)11 (Guidance for member states on solid biomass criteria)	DRAX (UK)	NTA 8080 (Netherlands)	Green Gold Label (Essent, Netherlands)	Laborelec System (Belgium)
4.2	Resource Conservation: Soil Nutrient Status/Erosion	•	—	•	•	•	•
4.3	Practices in Place to Protect Chemical, Biological, and Physical Properties of Soils	—	—	—	•	•	•
4.4	Best Management Practices	—	—	—	—	—	—
4.5	Minimize Biomass Harvest in Nutrient Poor, Shallow , or Steep Sloped Soils	—	—	—	—	—	—
5	**Maintenance of Forest Contribution to Global Carbon Cycles**						
5.1	Life Cycle Assessment Used to Determine if Whether Management and Supply Chain Systems Will, over Some Unit of Time, Lead to a Net Reduction in Non-Renewable Greenhouse Gas (GHG) Emissions Compared to Conventional Fossil Fuel Systems Needed to Produce the Same Amount of Energy. Modified from Lal et al. 2012	•	•	•	•	•	•
5.2	Management of Biogenic Carbon Flows in Forest Ecosystems so that GHG Reduction Benefits Are Realized Through Carbon Storage	•	•	•	•	•	—
5.3	Efficient Conversion of Biomass to Energy	•	•	—	—	—	—
6	**Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies**						
6.3	Investment in Forest Sector (i.e., Harvest Equipment Necessary to Produce Biomass	5	—	6	7	7	8
6.5	Employment and Community Needs	5	—	6	7	7	8
6.5.1	Local/Regional Economic Opportunity for Loggers and Haulers	5	—	6	7	7	8
6.5.2	Local/Regional Economic Diversity/Stability	5	—	6	7	7	8
6.5.3	Consultation and Transparency: Public Information	5	—	6	7	7	8
6.5.4	Consultation and Transparency: Public Input/Feedback	5	—	6	7	7	8
7	Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management						
7.1	Legal, Institutional and Economic Framework for Sustainable Biomass Procurement	•	—	—	•	—	—
7.1	Extent to which the Legal Framework (Laws, Regulations, and Guidelines) Supports the Conservation and Sustainable Management of Forests.	—	—	—	—	—	—
7.1.8	Employment Requirements: Mandatory Credentialing and Training for foresters and loggers.	—	—	—	—	—	—
7.1.9	Forest Practices Regulations and Guidelines: Compliance Provisions	—	—	—	—	—	—

Criteria		EC-RED Requirement Directive 2009/28/EC (liquid fuels)	Report COM (2010)11 (Guidance for member states on solid biomass criteria)	DRAX (UK)	NTA 8080 (Netherlands)	Green Gold Label (Essent, Netherlands)	Laborelec System (Belgium)
7.2.0	Extent to which the Institutional Framework Supports the Conservation and Sustainable Management of Forests	—	—	—	—	—	—
7.2.6	Forest Planning: Management Plan	—	—	—	—	•	—
7.2.7	Forest Planning: Mapping	—	—	—	—	•	—
7.2.8	Forest Planning: Timber Inventory	—	—	—	—	•	—
7.2.9	Forest Planning: Sustained Yield	—	—	—	—	•	—
7.2.11	Silviculture: Reforestation—Regeneration	—	—	—	—	•	—
7.2.12	Silviculture: Silvicultural Systems	—	—	—	—	•	—
7.2.12.1	Silviculture: Clearcutting	—	—	—	—	•	—
7.2.13	Silviculture: Retention and Residual Trees/Stands	—	—	—	—	—	—
7.2.14	Silviculture: Reforestation—Site Preparation	—	—	—	—	—	—
7.2.15	Silviculture: Reforestation—Genetics	—	—	—	—	—	—
7.2.16	Silviculture: Stand Management—Stocking Control	—	—	—	—	—	—
7.2.18	Silviculture: Stand Management—Application of Pesticides	—	—	—	—	—	—
7.2.19	Silviculture: Stand Management—Prescribed Fire	—	—	—	—	—	—
7.2.20	Special Treatments: Salvage Harvests	—	—	—	—	—	—
7.4	Capacity to Measure and Monitor Changes in the Conservation and Sustainable Management of Forests	—	—	—	—	•	—
7.4.2	Monitoring Environmental Considerations	—	•	—	•	•	—
8	**Sustainable Procurement**						
8.1	Evidence that a Sustainable Procurement Approach Is Included	9	10	—	•	•	•

•	Criteria or indicator included in standard or policy that specifically mentions issue.
—	Criteria or indicator NOT included in standard or policy that specifically mentions issue.
1	Exclusion of lands with high biodiversity value
2	Initial pledge to "not adversely affect protected or vulnerable biodiversity and where possible we will give preference to biomass production that strengthens biodiversity."
3	Exclusion of lands designated for nature purposes as of January 2008
4	Exclusion of biodiverse forest with no significant human intervention
5	Reporting obligation to the EC on social impacts in regions that are significant source of feedstock: Child labor, wages, freedom of unions/association, land use rights
6	Pledge to "contribute to local prosperity in the area of supply chain management and biomass production. . . . contribute to the social well-being of employees and the local population in the area of the biomass production."
7	Social aspects mentioned, but do not align with stated criteria.
8	Social aspects mentioned, but lacking specific criteria and indicators.
9	Policy requires member states to report on specific outcomes of biofuels sourcing. Traceability of sourcing is implicit in this policy.
10	Policy calls for member states to develop their own sustainability programs that address certain sustainability issues. Traceability of sourcing is implicit in this policy.

APPENDIX 3

Inclusion of wood residues, products from biomass, forestry in green labeling of electricity

	Eugene (EU)	Ecolabel UZ46 (Austria)	BraMIljovel (Sweden)	Econergla (Finland)	Milleukeur (Netherlands)	Green Power (Australia)	Green—e (USA)	Env. Choice (Canada)	Gruner Strom Label (Denmark)	OK Power (Denmark)	Nature Made Basic (Switzerland)	Nature Made Star (Switzerland)
Eligible sources of biomass												
Forestry	•	•	•	•		•						
Products from biomass (pellets)		•										
Wood product residues	•	•				•	•	•	•			
Eligible waste												
Biodegradable unseparated urban solid waste	—	—	—	—	—	•	—	•	—	—	—	—
Separated biodegradable waste	•	•	•		•	•	•	•	•	•	•	•
Demolition wood	—	—	—	—			•	—	•	•	•	•
Includes criteria/guidelines on												
GMOs			•								•	
Origin of biomass	•		•	•		•				•		•
Agriculture/soil	•		•	•	•					•	•	•
Wood residues		•								•		
CHP	•				•	•	•	•		•		
Co-firing	•		•	•	•	•	•	•		•		
Auxiliary energy			•	•								

• Indicates that criteria are included or that source of biomass is eligible.
— Indicates that a biomass source is ineligible.

Source: Vis, Vos and Van den Berg 2008

APPENDIX 4

GHG requirements in EU sustainability programs

Sustainability scheme	Level of governance	Description of requirements
Report COM(2010)11	EU-level suggested requirements for GHG LCA	Includes a suggested GHG calculation methodology for countries and energy companies to use in their own policies and/or sustainability schemes to determine if minimum GHG savings from biomass are at least 35% (**rising to 50% in 2017 and 60% in 2018** for new installations) compared to the EU's fossil energy mix. GHG LCA for solid biomass must include conversion efficiency of the end use. Default values for GHG emissions are offered by fuel type and source. Exclusion of lands with high carbon stock (primary forest, wetlands, peatlands) that have recently been converted into cropland.
EC-RED	EU-level binding GHG LCA requirement for liquid transportation fuels	Liquid biofuels must demonstrate **a ≥ 35% GHG reduction compared to reference fuel**, increasing to a **50% reduction in 2017, and a 60% reduction in 2018**. Exclusion of lands with high carbon stock (primary forest, wetlands, peatlands) that have recently been converted into cropland.
NTA 8080	The Netherlands	Requires facilities to document a **50–70% GHG reduction over natural gas or coal**. Documentation of GHG LCA is voluntary but mandatory if incentives are used.
Green Gold Label	The Netherlands (GGL is intended for use by energy companies in other countries as well)	GGL 8 for GHG Balance was developed in anticipation of the Dutch NTA 8080 and thus references that standard, **requiring a 50–70% GHG emissions savings over the reference fossil fuel**. The calculation method is based on the Renewable Energy Directive (RED) and covers the whole supply chain.
UK Renewable Obligations	The UK	Utilities receiving renewable obligation credits are required to report on GHG emission reductions on a comparative basis to fossil fuels, and demonstrate a minimum **60% GHG emissions savings for electricity generation facilities**. Biomass sourcing is restricted from lands with high carbon stocks (e.g., primary forest). The UK Department of Energy and Climate Change requires that energy producers document the carbon intensity of their feedstocks using a spreadsheet calculator.
DRAX	The UK	Preference for biomass sources that reduce GHG emissions and "not result in a net release of carbon from the vegetation and soil of either forests or agricultural lands." **Includes a pledge to reduce emissions by 60–70% compared to coal.**
Laborelec Verification System	Belgium	Includes a detailed calculation methodology for energy and/or GHG balance of the supply chain to determine GHG impacts of the supply chain while not seeking to reach the Report COM (2010)11 targets for GHG reductions. GHG LCA begins after harvest and does not include GHG effects of forest harvest and regeneration.

APPENDIX 5

Federal, state, and private incentives for NIPF landowners in the Southeast

State	Number of Federal agency-administered programs	Number of State agency-administered programs	Number of privately administered programs
Alabama (21 programs)	10 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	7 programs (AL Agricultural & Conservation Development Commission Program, property tax abatement, TREASURE Forest, SPBP, FSP, FLP, LIP)	4 programs (AL Tree Farm Program, Longleaf Alliance, State Woodland owners Association, Statewide Forest Trust
Arkansas (18 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	6 programs (SPBP, FSP, FLP, LIP, property tax abatement, AR wetland and riparian zone tax credit)	1 program (AR Tree Farm Program)
Florida (22 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	8 programs (SPBP, FSP, FLP, LIP, property tax abatement, Longleaf Pine Ecosystem Restoration Private Landowner Incentive Program, Florida Rural Development program, Rural and Family Lands Recovery program)	3 programs (FL Tree Farm Program, Longleaf Restoration Program, statewide forest trust)
Georgia (20 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	6 programs (Team Agriculture Georgia, property tax abatement, SPBP, FSP, FLP, LIP)	3 programs (Longleaf Alliance, statewide forest trust, GA Tree Farm Program)
Kentucky (20 programs)	10 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 2 U.S. FWS programs)	7 programs (KY habitat improvement program, property tax abatement, SPBP, FSP, FLP, LIP)	3 programs (state Forest Trust, KY Woodland Owners Association, KY Tree Farm Program)
Louisiana (19 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	6 programs (property tax abatement, LA Forestry productivity program, SPBP, FSP, FLP, LIP)	2 programs (LA Tree Farm Program, Longleaf Alliance)
Mississippi (21 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	7 programs (property tax abatement, reforestation tax credit, MS forest resource development program, SPBP, FSP, FLP, LIP)	3 programs (statewide forest trust, MS Tree Farm Program, Longleaf Alliance)
North Carolina (22 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	7 programs (NC Forest Agriculture Cost-Sharing Programs, NC Forest Development program, tax abatement program, SPBP, FSP, FLP, LIP)	4 programs (statewide forest trust, NC woodland owners association, NC Tree Farm Program, Longleaf Alliance)
South Carolina (20 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	6 programs (SC Forest Renewal Program, property tax abatement, LIP, FSP, FLP, SPBP)	3 programs (statewide forest trust, SC Tree Farm Program, Longleaf Alliance)
Tennessee (19 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	7 programs (TN Agricultural Enhancement Program, property tax abatement, Farm Wildlife Habitat Program, SPBP, LIP, FSP, FLP)	1 program (TN Tree Farm Program)
Texas (19 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	6 programs (Statewide Forest Trust, SPBP, LIP, FLP, FSP)	2 programs (TX Tree Farm Program, Longleaf Alliance)
Virginia (23 programs)	11 programs (BCAP, CRP, CSP, EWP, EQIP, HFRP, WRP, WHIP, 3 U.S. FWS programs)	11 programs (VA riparian buffer tax credit, Reforestation of Timberlands program, BMP cost share program, VA Pine Bark beetle Prevention Program, VA BMP tax credit nutrient and pesticide application equipment, tax abatement program, Firewise Virginia, SPBP, LIP, FSP, FLP)	1 program (VA Tree Farm Program)

Source: Greene et al. 2010)

APPENDIX 6

Comparison of BMP programs and Biomass Harvesting Guidelines to sustainability criteria

		BMP programs											Biomass Harvesting Guidelines	
Criteria		TX	LA	MS	AL	TN	KY	VA	NC	SC	GA	FL	Kentucky BHGs	Forest Guild SE
1	**Conservation of Biological Diversity**													
1.1	Species Diversity	N	N	N	N	N	N	N	N	P	N	N	N	P
1.1.1	Important Species (i.e., state natural heritage) identified in a forest management plan	N	N	N	N	N	N	P	N	P	N	N	P	A
1.2	Provisions for Genetic Diversity	N	N	N	N	N	N	N	N	N	N	N	N	N
1.3	Important Wildlife Habitat Across Landscape	N	N	N	N	N	N	N	N	P	N	N	N	P
1.4	Important Wildlife Habitat at the Stand Level	N	N	N	N	N	N	N	N	P	N	P	A	A
1.5	Amount and Distribution of Organic Matter Present on Forest Floor	N	N	N	N	N	N	P	N	N	N	N	A	A
1.6	Ecological Reserves/Special Area/Protected Areas	N	N	N	N	N	N	P	N	N	N	P	P	P
1.7	Rare forest types (e.g., Old Growth)	N	N	N	N	N	N	N	N	N	N	N	P	A
1.8	Riparian and Aquatic System Biological Resources	N	N	N	N	N	N	P	N	N	N	N	N	P
2	**Maintenance of Productive Capacity of Forest Ecosystems**													
2.1	Ecological Function/Maintenance of Forest Nutrient Capital over the Long-term	N	N	N	N	N	N	N	N	N	N	N	P	P
2.2	Landscape-Scale Spatial Patterns (e.g., fragmentation and connectivity)	N	N	N	N	N	N	N	N	N	N	N	N	P
2.3	Representation of Regionally Appropriate Forests and Structural Diversity	N	N	N	N	N	N	N	N	N	N	N	N	A
2.4	Retention of Deadwood (Coarse Woody Debris, Fine Woody Debris, Snags)	N	N	N	N	N	N	P	N	N	N	N	A	A
3	**Maintenance of Forest Ecosystem Health and Vitality**													
3.1	Forest Protection/Health: Fire	P	P	P	P	P	P	P	P	P	P	P	N	P
3.2	Forest Protection/Health: Exotic Species/ Noxious Weeds	N	N	N	N	N	N	N	N	N	N	N	N	P
3.3	Forest Protection/Health: Pests and Pathogens	N	N	N	N	N	N	P	N	N	N	N	N	P
3.4	Forest Protection/Health: Hazardous Materials/Debris/Waste	A	A	A	A	A	A	A	A	A	A	A	N	N
3.5	Harvest Operations and Access: Forest Roads	A	A	A	A	A	A	A	A	A	A	A	N	N

Criteria		BMP programs											Biomass Harvesting Guidelines	
		TX	LA	MS	AL	TN	KY	VA	NC	SC	GA	FL	Kentucky BHGs	Forest Guild SE
3.5	Vehicles and Machinery Used in Harvest Should Cause Minimal Damage to Ecosystem	P	N	N	N	N	N	P	N	N	N	N	N	A
4	**Conservation and Maintenance of Soil and Water Resources**													
4.1	Resource Conservation: Water Yield and Water Quality	A	A	A	A	A	A	A	A	A	A	A	P	P
4.2	Resource Conservation: Soil Nutrient Status/Erosion	P	P	P	P	P	P	P	P	P	P	P	P	P
4.2.1	Resource Conservation: Soil Erosion	P	P	P	P	P	P	P	P	P	P	P	P	P
4.3	Practices in Place to Protect Chemical, Biological, and Physical Properties of Soils	P	P	P	P	P	P	P	P	P	P	P	P	P
4.4	Best Management Practices	A	A	A	A	A	A	A	A	A	A	A	P	P
4.5	Minimize Biomass Harvest in Nutrient Poor, Shallow, or Steep Sloped Soils	N	N	N	N	N	N	N	N	N	N	N	P	P
5	**Maintenance of Forest Contribution to Global Carbon Cycles**													
5.2	Management of Biogenic Carbon Flows in Forest Ecosystems so that GHG Reduction Benefits Are Realized Through Carbon Storage	N	N	N	N	N	N	N	N	N	N	N	N	P
7	**Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management**													
7.1.9	Forest Practices Regulations and Guidelines: Compliance Provisions	N	N	N	N	N	N	A	N	N	N	N	N	N
7.2.6	Forest Planning: Management Plan	N	N	Y	N	N	N	P	N	P	N	N	P	P
7.2.7	Forest Planning: Mapping	A	A	A	A	A	A	A	A	A	A	A	N	A
7.2.8	Forest Planning: Timber Inventory	N	N	P	N	N	N	P	N	N	N	N	N	N
7.2.9	Forest Planning: Sustained Yield	N	N	P	N	N	N	N	N	N	N	N	N	N
7.2.11	Silviculture: Reforestation—Regeneration	P	P	P	P	P	P	P	P	P	P	P	P	N
7.2.12.1	Silviculture: Clearcutting	N	N	N	N	N	N	P	N	N	N	P	N	N
7.2.13	Silviculture: Retention and Residual Trees/Stands	P	P	P	P	P	N	P	N	N	N	N	A	A
7.2.14	Silviculture: Reforestation—Site Preparation	A	A	A	A	A	A	A	A	A	A	A	P	N
7.2.18	Silviculture: Stand Management—Application of Pesticides	A	A	A	A	A	A	A	A	A	A	A	N	N
7.2.19	Silviculture: Stand Management—Prescribed Fire	A	A	A	A	A	A	A	A	A	A	A	N	N
7.2.20	Special Treatments: Salvage Harvests	N	N	N	N	N	N	P	N	N	N	N	N	A

A = Applicable, P = Partially applicable, N = Not applicable

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