Ecological sustainability of solid wood bioenergy feedstock supply chains: Local, national and international policy perspectives

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Task 40: Sustainable International Bioenergy Trade

Authors

Evelyne Thiffault, Miren Lorente and Jessica Murray
Natural Resources Canada – Canadian Forest Service
www.nrcan.gc.ca/forests

Uwe Fritsche and Leire Iriarte
International Institute for Sustainability Analysis and Strategy
www.iinas.org

Jody Michelle Endres and James S.N. McCubbins
University of Illinois
www.illinois.edu/

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Authors:

Evelyne Thiffault, Miren Lorente and Jessica Murray (Natural Resources Canada – Canadian Forest Service)

Uwe Fritsche and Leire Iriarte (International Institute for Sustainability Analysis and Strategy)

Jody Michelle Endres and James S.N. McCubbins (University of Illinois)

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1. Introduction

The past years have seen an important push in the forestry sector towards a more diversified, market-driven focus and the generation of more value from the forest, while at the same time ensuring protection of environmental assets. Bioenergy and biorefining are particularly seen as promising pathways. At the same time, as countries, industry and communities seek ways to reduce greenhouse gas (GHG) emissions to address climate change, forest biomass for bioenergy is seen as an appealing alternative to fossil fuels. Therefore, with developing domestic and export markets for forest bioenergy products, there is a growing interest for sourcing biomass from traditional as well as non-traditional feedstock types available in forests.

Currently, there are several on-going discussions on the sustainability of biomass production for solid bioenergy, both at the local/regional and international levels. However, the stability of solid bioenergy sourcing and international markets has yet to be secured. Multiple levels of governance designed to ensure sustainable forest management (SFM) already exist with regard to pulp&paper feedstocks and timber production, by means of international process on SFM or voluntary forest certification schemes (e.g. PEFC and FSC). Additionally, new standards, criteria and indicators targeting specifically bioenergy products are being developed, aimed to address specific concerns raised by forest bioenergy. Private sector initiatives - apart from the voluntary SFM initiatives - are ongoing, especially the electric utilities' Sustainable Biomass Partnership (formerly: Initiative of Wood Pellet Buyers). At this moment, policy choices by both domestic and international markets can still be made on how solid bioenergy supply chains and markets are governed.

Europe is an important market for wood pellets, and biomass consumption for heat and electricity is expected to double from now until 2020. In 2009, the *EU Renewable Energy Directive 2009/28/EC* (referred to as *RED*; EC 2009) mandated that 20% of the EU's final energy consumption consists of renewable sources by 2020, and that 10% of its road transport fuels should be from renewable sources. For the latter, the *RED* established mandatory sustainability criteria for biofuels and bioliquids that are to be met if such biofuels are to be counted against the 10% target. Currently, no such binding criteria exist for solid or gaseous bioenergy used for electricity and heat, but discussions on extending the sustainability requirements to all bioenergy carriers are on-going and were reported in COM(2010)11 final - Report from the commission to the council and the European parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling (EC 2010b). . The criteria are meant to apply to all forms of forest biomass sourced from lands, irrelevant of species, tree parts, types of production systems etc. that constitute or provide the feedstock.

The EC, stating the concerns raised by various stakeholders, considers that public intervention is justified because there is a risk of negative environmental impacts with the intensified use of biomass sourced both domestically and from outside of the EU (EC 2010b). The policy objective of the regulator is therefore to guarantee the sustainable production of bioenergy feedstocks, and its operational objective is to establish sustainability requirements that are efficiently dealing with issues of sustainable biomass provision.

A good understanding of the specific contexts of existing policy and forest management schemes of countries that an overarching policy such as the *RED* will affect, such as Canada, the United States of America (US) and Russia, which are main or potential forest biomass exporters to the EU, is crucial. Otherwise, such policies may create barriers to mobilization of

biomass supply chains, both at the domestic and international levels. The consequences of non-alignment between the operational reality of local forest conditions and management and *RED* sustainability principles may create non-tariff barriers for export and create hurdles and possibly conflicts in international flows of forest biomass for bioenergy.

The aim of this project is to provide background information on the regulatory and operational aspects of sustainability criteria for solid woody bioenergy feedstocks to policymakers and other stakeholders for the development and possible extensions of the *EU RED*. The focus is on land management sustainability criteria, which address all types of woody biomass feedstocks that can be sourced from a land, irrelevant of types of production systems, species, tree parts etc. The objective is to compare and contrast the proposed EU sustainability requirements for land use and management for the use of solid biomass with existing regulations and practices of forest biomass supply chains for three case studies, i.e., Canada the United States of America (US)., and Russia, and/or for specific provinces, states or regions within these areas. The report provides a review and discussion of i) definitions for land use assessment, inventory and reporting that are relevant for distinguishing sustainable supply chains from those considered unsustainable according to existing or proposed land management sustainability criteria and ii) best management practices and regulations for sustainable forest biomass harvesting for bioenergy at the federal level and/or provincial/state/regional level.

The report first provides a brief overview of development of policy and criteria related to sustainability of bioenergy in the EU and in key biomass importer Member States (Unted Kingdom, the Netherlands and Belgium). The following sections then provide an thorough review of policy, regulations and practices of Canada and the United States, with a special focus of key biomass producing provinces/states (British Columbia, Ontario and Quebec in Canada, Georgia, New York and Massachusetts and California in the US); this in-depth analysis of the Canadian and American contexts was made possible due to the abundance of information available for those countries, but was also found necessary due to the scarcity of syntheses on this information. The next section then provides an overview of the policy and practices for land and forest management in Russia, with a focus on the region of Northwest Russia, based on the information that was possible to gather from this area. The report concludes with a discussion and main conclusions stemming from the analysis of the case studies.

2. Background: EU sustainability requirements for bioenergy

2.1. EU Renewable Energy Directive

Within the framework of the *EU RED* (EC 2009), adopted in April 2009, the European Parliament and the Council of the European Union has proposed several sustainability criteria for biofuels and bioliquids. Two themes were addressed: biodiversity protection mainly by means of avoiding land use changes of certain types of land (Table 1) and GHG emission savings. The GHG gas emission saving from the use of biofuels and bioliquids should be at least 35% (50% in 2017) and 60% in new installations from 2017 (*Art. 17.2*). Moreover, the sustainability criteria in *RED* limit biomass harvest for bioenergy feedstocks to certain areas, creating “no-go” areas, with the objective of protecting biodiversity, carbon (C) stocks and soil, water and air quality. Lands that are excluded for producing biofuels and bioliquids are lands designated prior to January 2008, with high biodiversity value (*Art. 17.3*), lands with high C stock (*Art. 17.4*) and peatlands (*Art. 17.5*).

1) Lands with high biodiversity value include primary forests, protected areas and highly biodiverse grasslands, whether or not the land continues to have the 2008 status. Therefore no biomass procurement is allowed from:

- **Primary forests**: defined as "forests where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed" (*Art. 17.3*). According to the *RED* (*Art. 69*), the sustainability criteria concerning primary forests should agree with the definition used in the *Forest Resources Assessment* (FRA) reports (Box 1) published by the Food and Agriculture Organization of the United Nations (FAO).

Box 1. *Forest Resources Assessment*

Since 1946, FAO has monitored the world's forests in 5 to 10-year intervals through the *Forest Resources Assessment* (FRA) Program (FAO 2012). Global assessments are elaborated in cooperation with each FAO's member country to report on evolving forest information needs. For example, the first assessment was designed to address the shortages of forest products. The main concern driving assessments until the nineties was the rate of deforestation, while FRA 2000 focused on a wider range of forest benefits and functions. The concept of sustainable forest management (SFM) was emphasized in FRA 2005, and was extended in the context of the most recent assessment, the FRA 2010 (FAO 2010a). This assessment is based on the thematic elements of SFM and includes both variables related to the extent, condition, uses and values of forest resources and the legal, policy and institutional framework guiding forests. This assessment is used as a reporting tool to several agencies, such as the International Tropical Timber Organization and Forests Europe.

- **Protected areas**: defined as areas "protected by law or by the relevant competent authority for nature protection purposes or for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature (Box 2)".

Box 2. International Union for Conservation of Nature (IUCN)

- **The organisation**: founded in 1948, IUCN is the world's first global environmental organization (IUCN 2013).
- **Mission**: to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.
- **Structure**: the work is framed by a Global programme which is coordinated by IUCN's Secretariat and delivered by member organizations, 14 commissions and theme-based programmes. One of these commissions is the IUCN's World Commission on Protected Areas.
- **Definition of protected areas**: "clearly defined geographical space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (IUCN definition 2008; IUCN 2012);
- **IUCN protected areas categories system**

Management category	*Title*
Ia	Strict nature reserve
Ib	Wilderness area
II	National park
III	Natural monument or feature
IV	Habitat / Species management area
V	Protected landscape / Seascape
VI	Protected area with sustainable use of natural resources

- **Highly biodiverse grasslands**: defined as "natural grasslands, that would remain in that stage in the absence of human intervention and which maintain the natural species composition and ecological characteristics and processes, or non-natural grasslands that would cease to be grassland in the absence of human intervention, and which is species-rich and not degraded".

2) Lands with high C stock include wetlands, continuously forested areas and other forested areas, and that no longer have the 2008 status (therefore where land conversion has occurred):

- **Wetlands**: defined as "lands covered with or saturated by water permanently or for a significant part of the year". Moreover, the reference to wetlands should take into account the definition laid down in the *Convention on wetlands of international importance* (Box 3), especially as Waterfowl Habitat (*Art. 73*).

Box 3. ***Convention on wetlands of international importance***

The Convention on Wetlands of International Importance, called the *Ramsar Convention* since it was signed in the Iranian city of Ramsar, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (Ramsar 2008). The Convention was signed in 1971 and it came into force in 1975. It is the only global environmental treaty that deals with a particular ecosystem, and the Convention's member countries cover all geographic regions of the planet (Ramsar 2013b). The *Ramsar Convention* defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (UNESCO 1994). Signatory nations should implement principles for the wise use of wetlands, that is, their "sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem". To do so, the convention calls for the establishment of wetland conservation policies to improve institutional and organizational arrangements, to address legislative needs, to increase knowledge and awareness of wetland values, to monitor the status of wetlands, to identify program priorities and to develop action plans for specific sites (Ramsar 2011).

- **Continuously forested areas**: defined as areas "spanning more than 1 ha with trees higher than five metres and a canopy cover of more than 30% or trees able to reach those thresholds in situ".

- **Other forested areas**: defined as "lands spanning more than 1 ha with trees higher than 5 m and a canopy cover of between 10% and 30%, or trees able to reach those thresholds in situ, unless evidence is provided that the C stock of the area before and after conversion is such that the GHG emission saving meets the *RED* criteria" (presently, at least 35% reduction).

3) Peatlands: The *EU RED* does not provide a peatland definition. However, the Directive refers to the *Ramsar Convention* (*Art. 73*; see also section on wetlands), where peatlands are considered a vital part of the world's wetland resources. More specifically, Parties to the Ramsar Convention recognize the importance of peatlands through the *Guidelines for global action on peatlands* (Box 4).

Box 4. ***Guidelines for global action on peatlands***

Ramsar Contracting Parties have recognized the global significance of peatlands through the *Guidelines for global action on peatlands* (Resolution *VIII.17;* Ramsar 2002). Under these guidelines, peatlands are named "landscapes with a peat deposit". Peat is defined as "dead and partially decomposed plant remains that have accumulated in situ under waterlogged conditions". According to the *Ramsar Convention* (Ramsar 2013a), peatlands occur primarily on inland wetlands, as non-forested (shrub or open bogs, swamps, fens) and forested (peat/swamp forests) peatlands. Peatlands account for 37% of the total area of Ramsar sites.

Table 1. Lands excluded for producing biofuels and bioliquids, i.e. no-go areas, according to the *EU Renewable Energy Directive 2009/28/EC* (*RED*; EC 2009)

***RED* criteria (EC 2009)**	**Lands (designated prior to January 2008) excluded for producing**	**Specific areas included**

	biofuels and bioliquids	
Conserving biodiversity	Lands with **high biodiversity value** (*Art. 17.3*) whether or not the land continues to have the 2008 status	**Primary forests** and other wooded land: forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed. This type of land follows the definition used by the Food and Agriculture Organisation of the United Nations (FAO) in its *Global Forest Resource Assessment* (*FRA*).
		Areas designated by law or by the relevant competent authority for nature **protection purposes**, or for the protection of rare, threatened or endangered ecosystems or species recognized by international agreements or included in lists drawn up by intergovernmental organizations or the International Union for the Conservation of Nature (IUCN).
		Highly biodiverse grasslands: "natural grasslands, that would remain in that stage in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes, or non-natural grasslands, that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded".
Preserving carbon reservoirs	Lands with **high C stock** (*Art. 17.4*) that no longer have the 2008 status	**Wetlands**: lands covered with or saturated by water permanently or for a significant part of the year (should take into account the definition laid down in the *Convention on Wetlands of International Importance*, adopted on 2 February 1971 in Ramsar).
		Continuously forested areas: lands spanning more than 1 ha with trees higher that 5 m and a canopy cover of more than 30% or trees able to reach those thresholds in situ.
		Land spanning more than 1 ha with trees higher than 5 m and a canopy cover of between 10% and 30%, or trees able to reach those thresholds in situ, unless evidence is provided that the C stock of the area before and after conversion is such that, when the methodology laid down in Annex V is applied, the conditions laid down in paragraph 2 of this article would be fulfilled.
Protecting peatlands	**Peatlands (**2008 status), unless evidence is provided that the cultivation and harvesting of raw material does not involve drainage of previously undrained soil (*Art. 17.5*)	**Peatlands** (no definition provided), though *RED* refers to the *Ramsar Convention* for the wetland category and, according to this Convention, peatlands are considered as a wetland type.

2.2. Extended EU criteria

Because of the wide variety of feedstocks and the low sustainability risks that domestic residues presented, binding criteria were not applied to solid and gaseous biomass in electricity, heating and cooling at EU level (EC 2010b). However, the EC suggested that solid and gaseous biomass should be subject to national schemes in conformity with *RED* criteria for biofuels and bioliquids (EC 2010b). The European Commission is currently working to broaden requirements for energy to ensure the sustainable procurement of forest biomass.

Moreover, in August 2013, a draft EC proposal for solid and gaseous bioenergy was leaked (EC 2013). It included provisions for installations with capacity equal to or above 1 MW_{el} and/or 2.5 MW_{th}. The leaked draft considers a GHG saving threshold of 60 % compared to fossil fuels; the definition of a harmonized GHG accounting methodology; the establishment of land criteria to avoid undesirable land use change; and the prohibition of the production of raw material in certain areas with high biodiversity value (unless evidence is provided that the production of the raw material did not interfere with nature protection purposes) or high carbon stock; as well as the requirement that forestry biomass be sourced only from

sustainably managed forests, according to international principles and criteria. It is still quite uncertain how this proposal will evolve and the timeframe to do that.

However, main biomass importer Member States such as the United Kingdom, the Netherlands and Belgium are working on national schemes particularly referred to solid biomass.

2.2.1. United Kingdom

The UK has put special focus to co-firing and heat production by means of various regulations (i.e. the Renewable Obligation or the Renewable Heat Incentive) and respective sustainability criteria were endorsed in 2013 (DECC 2013a;b). From April 2014 onwards it would be needed to report against performance and from April 2015 these sustainability requirements will be mandatory (DECC 2013a). In addition to the GHG trajectories, other criteria refer to land use and sustainable forest management. The land criteria distinguish between virgin wood and all other non-waste biomass including energy crops.

Virgin wood or feedstocks made from virgin wood need to comply with the sustainable forest management criteria based on the UK Timber Procurement Policy. This policy sets out that timber and wood-derived products have to be procured from a legal and sustainable source.

To show evidence of compliance with this definition, two categories have been established (Fripp 2013): Category A, which assures compliance by means of a forest certification scheme approved by the Central Point of Expertise on Timber Procurement and Category B, that comprises equivalent credible evidence.

2.2.2. The Netherlands

In September 2013, the National Energy Agreement for Sustainable Growth was approved in The Netherlands with the signature of more than 40 organizations (Nellen 2013). Among the provisions, the co-firing ambitiousness limit was established at 25 PJ, with a current consumption of about 14 PJ.

The discussion on how to extent the requirements on sustainability from the NTA8080[1] to include, among others, sustainable forest management is beind leaded by an Expert Group on Sustainability Criteria (composed of representatives from NGOs, utilities and policymakers). The sustainability framework is expected to be published sometime in2014.

2.2.3. Belgium

In Belgium there are various schemes to promote heat, electricity and CHP (Goh, Junginger 2011; Pelkmans 2013). Sustainability is high in the agenda, including different measures: i.e. in Flanders (regional) woody resources are not eligible for green certificates if they can be used by the wood processing industry (audit needed) and when biomass from waste can have a valorisation by recycling into materials, fodder, etc., it is not eligible.

[1] The NTA 8080 is the Dutch voluntary norm developed for all biomass sources (NEN 2009) and includes social, economic and environmental criteria.

Other provisions state the minimum efficiency requirements or that wood pellets for use in non-industrial heating installations have to be chemically untreated wood from certified forests.

2.2.4.Proposals for EU-WIDE Criteria

Since there are no published sustainability schemes for forest management, we decided to use the series of criteria and indicators for sustainable biomass provision from forests proposed by Fritsche et al. (2012), and summarized in **Error! Reference source not found.** ndicators are grouped under three criteria: sustainable forest management (SFM), protecting biodiversity and net GHG reduction. These indicators should be respected unless evidence is provided that other indicators are maintained or enhanced.

Although some criteria are common with those described for "no-go" areas, most of them are more specific (Fritsche et al. 2012).

Table 2. Criteria and indicators proposed in the report *Sustainability criteria and indicators for solid bioenergy from forests*

Criterion	Indicators
C1.Protecting Biodiversity	Biomass should not be harvested in **High Conservation Value Forest** (highly biodiverse forests and other wooded lands), except if biomass harvest is performed in order to control invasive species, enhance the biological value of the habitats, or reduce natural hazards risks (wildfire, pest attacks etc...) which are not part of natural forest life-cycles.
	Primary forest (old-growth forest or tropical primary forest) should be excluded unless evidence is provided that biomass harvest does not interfere with nature protection purposes. Interim safeguard.
	Bioenergy from forests residues may be sourced from **forests with high risk of hazards or from salvage logging**, taking into account all other indicators.
	At least 100 m of riparian ecosystems from the watercourse is established to protect freshwater resources. A thinner buffer could be established if evidence is provided that other indicators are maintained or enhanced.
	An adequate amount of residues is evenly left on the ground to protect biodiversity. If no more adequate thresholds are available at biome or landscape level a general recommendation is that residue harvesting not exceed 2/3 of total available harvest residues. More intensive harvesting could be performed if evidence is provided that other indicators are maintained or enhanced.
	Residual harvesting should be performed in a way that does not allow the occurrence of **pioneering species**.
	In case that retention forestry is performed in previous activities**, live cavity trees, den trees, other live decaying trees, and** snags left should be respected. When the retention of biological legacies is not considered in previous activities and in the absence of a more specific threshold at biome or landscape level, at least 30 snags/ha should be kept. Larger amount of snags, live cavity trees, den trees etc. could be harvested if evidence is provided that biodiversity is maintained or enhanced.
C2.Sustainable Forest Management	**Forest management plan** or equivalent tool exists and is in practice.
	Woody bioenergy feedstocks are supplied in accordance with **EU Timber Regulation** (EU No 995/2010).
	Residues removal is allowed in areas without **nutrient depletion risks** (green areas) or with risks that could be prevented (yellow areas) according to **soil nutrient risk maps developed at stand level**.
	Fertilization, including wood ash recycling is allowed in order to prevent nutrient depletion. Wood ash recycling must ensure that no heavy metal loads (above current levels in forest soils) occur. Its application should be in accordance with regional guidelines or with general recommendations set up at biome or landscape level.
	Stumps and roots are left in the forest, only selected extraction without negative erosion and nutrient depletion impacts.
	No harvesting in area having **steep slope** (>35 degree). If harvest is performed in higher slopes areas evidence should be provided that the thresholds defined for other indicators are maintained.
	Residue removal is allowed from soils with low (green areas) to medium (yellow areas) **disturbance risk** according to the **soil disturbance maps developed for this purpose at stand level.**

Net GHG Reduction	GHG reduction requirements have to take into account **all carbon stock changes in the forest** (live biomass, litter, soil) as well as emissions along the production chain (harvesting, processing and transport). As for the LUC emissions, the carbon stock changes in the forest have to be annualized in a **20 year time frame**. Indirect impacts (market mediated) have to be internalised in the GHG accounting with the introduction of correction factors (such as iLUC, iWUC). The GHG **savings** compared to fossil energy systems should be, at least, **60 %.**

Source: (Fritsche et al. 2012); iLUC: indirect Land Use Change; iWUC: indirect Wood Use Change

3. Sustainability in Canada, the United States and Russia

3.1. Canada

3.1.1 Introduction

Canada contains 348 million ha of forest land (40% of Canada's land base), and an additional 42 million ha of other wooded land (NRCAN 2012b). In total, this accounts for 10% of the world's forests and 30% of global boreal forests (NRCAN 2012a; b). There are 230 million ha of managed forest, operated sustainably and often simultaneously for various objectives (NRCAN 2012b). For example, management objectives may include environmental protection, collection of non-timber forest products, timber harvesting, recreation and public use, or traditional use by First Nations. The primary objective of Canadian provincial forest management policies, which apply to 77% of forests in Canada, is SFM and ensuring that management does not compromise the quality and extent of the forest resource and its ability to meet the needs of future generations (NRCAN 2011).

The Canadian forest products industry has declined over the past years due to the recent global economic downturn and changes in paper consumption. This has led to increased interest in diversification of forest products, such as solid forest bioenergy (NRCAN 2013b). Production of wood pellets for bioenergy production is most developed in the province of British Columbia (BC), which is experiencing a mountain pine beetle (*Dendroctonus ponderosae*) epidemic since 1999, leaving 18.1 million ha of standing dead trees available for salvage harvest over the next twenty years (MEMPR 2008; MFLNRO 2012a; b). BC's wood pellet production capacity accounted for 66% of Canada's total pellet capacity in 2011. Canada's Atlantic provinces accounted for 18% of Canadian pellet production capacity the same year, whereas Quebec accounted for 11%, and Ontario for 1% (Province of British Columbia 2011).).

Wood pellet production capacity in Canada is approximately 3 million metric tonnes per year, with another 300 000 metric tonnes of capacity under construction (Canbio 2012). In 2011, nearly 1 million tonnes of these pellets were exported to EU nations, which accounted for 38% of total EU imports, with the United Kingdom and the Netherlands importing 77% of this amount (Gilsenan 2012). The EU is currently an important export market for Canadian-produced pellets, and will likely continue to be so in the coming decades (Cocchi 2011).

The vast majority (93%) of Canadian forests are publicly owned, with 16% under federal jurisdiction, and the remaining 77% under provincial purview (NRCAN 2011). All provinces have policies to address forest management practices on public (Crown) land, based on the concept of SFM. The Canadian Council of Forest Ministers (CCFM), a collaboration of provincial and federal representatives at the federal level, has stated that forestry in Canada will be based on SFM and the criteria and indicators of the international *Montreal Process agreement* (CCFM 2012).

The direct or shared role of the Canadian federal government in forestry is focused on management of the limited federal land area, science and technology, international relations, trade and investment, industrial and regional development, national statistics, climate change, protecting water, Aboriginal affairs, and environmental regulations. The federal government also represents Canada in the international arena on forest issues and is responsible for Canada's international obligations in the management of its forests.

Natural resources in Canada are thus primarily under provincial jurisdiction and so forest management policy, including that related to forest biomass harvesting, is largely a

responsibility of the provinces. The provinces make the laws and regulations governing the use, management, and protection of the forest resource and have also developed the operational guidelines. Provincial forest management policies and associated regulations and guidelines are applicable to all forestry activities, regardless of the harvested materials' end-use (Statutes of Ontario 1994; Statutes of British Columbia 2002; Statutes of Quebec 2010). This means that even with development of the bioenergy market, forest management activities on Crown land must all adhere to sustainability principles. Nonetheless, due to the unique pressure bioenergy production places on managed forests (which can make it desirable to harvest what was previously considered non-merchantable wood) new biomass harvest policy and regulations have been developed for the three provinces we examined.

Since there is no specific biomass policy in BC, any harvest occurring in the province needs to adhere to the requirements of the *Forest and range practices Act* (Statutes of British Columbia 2002) and its associated regulations and supporting documents. BC published the *BC bioenergy strategy* in 2008, which sets goals for investing in and developing biofuel production. One method is to establish a comprehensive biomass inventory to maximize waste-to-energy opportunities (MEMPR 2008). This inventory provides energy producers with greater access to information in order to develop new bioenergy opportunities (MEMPR 2008). The annual allowable cut has been increased in BC in order to capture value from this deteriorating resource by removing salvageable mountain pine beetle damaged timber, which is available for approximately 20 years, after which its quality will have declined too drastically. Mountain pine beetle-killed and non-recoverable pine for traditional timber products may account for up to 34% of the province's available biomass resources; biomass resources from sustainable forestry accounts for 53%, and the remaining 13% is comprised of sustainable agriculture and municipal solid waste resources (MEMPR 2008).

Ontario developed its *Forest biofibre policy direction* in 2008 (OMNR 2008). This policy provides general direction for the allocation and use of forest biomass Ontario's Crown forests (OMNR 2008). Allocation, management, and sustainable use of forest biomass are to follow the existing guidance of legislation and policy direction that apply to all other forestry operations on Crown land. Allocation decisions prioritize opportunities for Aboriginal communities, consider the long-term competitiveness and viability of the forest industry, assess how use of biomass will contribute to Ontario's renewable energy commitments, and aim to diversify the forest industry. Licenses for forest biomass use are issued under the *Crown forest sustainability Act* (Statutes of Ontario 1994), in the same manner as existing forest management projects. Only areas already approved for use under a forest management plan may be selected for harvest, and this may be done so according to "acceptable" forest operation prescriptions based on existing requirements and direction in forest management guides. As well, forest in areas that have previously been harvested and where forest renewal requirements will not be compromised can be used for biomass sourcing (OMNR 2008).

In the province of Quebec, the *Forest Act* (Statutes of Quebec 1986; replaced since April 1, 2013) did not originally allow harvesting of forest biomass from Crown land until the *Forest biomass allocation program for public lands* came into force in the public forests in 2008 (MRNF 2009a). This program makes it possible for the provincial government to allocate certain volumes of forest biomass in specific management units to users for a period of five years, awarded through a competitive bidding process (MRNF 2009b). The regional context of proposed biomass development projects is taken into consideration, and regions may also make their own calls for proposals for biomass harvest initiatives. The *Climate change action plan* (MDDEFP 2008b), which outlined assistance programs for the sustainable use of forest

biomass, and the *Sustainable development Act* (Statutes of Quebec 2006), which objective is to establish a new management framework within the Administration, provided background for the development of an action plan on biomass. In February 2009 the government of Quebec implemented a plan of action entitled *Developing the value of forest biomass* (referred to as *Biomass action plan*) with the objective of replacing non-sustainable energy forms with clean, renewable forms, thereby reducing GHG emissions (MRNF 2009a). Currently, the province of Quebec does not have specific biomass harvesting policy, but rules relating to forest biomass harvesting are being integrated in the *Sustainable forest management regulation*, which is in preparation. In the meantime, biomass harvesting should follow rules dictated by the *Sustainable forest development Act* (Statutes of Quebec 2010).

3.1.2. Canada'S legislation and the EU RED

Canada's operational definitions and regulations of lands with high biodiversity value and carbon stock

In the following sections, we describe how the 'no-go areas' as defined in the *RED* sustainability criteria listed in Table 1 are addressed in Canada, both at the federal and the provincial level.

Primary forests

In Canada, the body responsible for national and international reporting about forests is the National Forest Inventory (NFI; NFI 2013). The NFI is currently coordinated by the Canadian Forest Service of the Ministry of Natural Resources Canada, under the guidance of the CCFM, with the collaboration of provincial and territorial jurisdictions (Gillis et al. 2005). The purpose of the NFI is to assess and monitor the extent, state and sustainable development of Canada's forests in a timely and accurate manner (Wulder et al. 2004). Using spatially explicit information from a sampling grid with 20 km x 20 km cells covering all of Canada's land area and aerial photos covering 2 km x 2 km plots at grid intersections, the NFI provides a national framework for collecting data on criteria and indicators to monitor sustainable development and for studying the factors affecting forest health (e.g., insect attack, disease infestation, pollutant deposition) and productivity (NFI 2004; 2013). The NFI is based on contributions of forest resource data from a host of agencies (the provinces, territories or their assigned delegates; NFI 2004)). Since the provinces have the jurisdiction for managing and monitoring their forest lands and forest resources, they are the main providers of data for NFI.

The concept of 'primary forest' is not used in any of the forest inventories compiled by the NFI and the suite of agencies in charge of forest resource assessments across Canada. However, to meet its obligation to the FAO, Canada still reports statistics of primary forest area in its Forest Resource Assessment (FRA) report. In the FRA Country Report 2010 to the FAO, Canada reports primary forests as "reserved" plus "not accessed" areas (FAO 2010b), an approach consistent with that of the United States. The "reserved" category includes areas that are not available for timber harvesting by law. The "not accessed" category refers to areas in which there is no presence of a transportation route (road, rail or water) within a 2 km radius. These areas were compiled by overlaying forest land, access network and protected areas maps (NFI 2008; FAO 2010b). A tri-lateral working group is coordinating the approach for mapping primary forests and other variables for the next FAO-FRA report due in 2015 (Stinson 2013; pers. comm.). Several options are currently being considered, but they all come with caveats that would either cause errors of omission (primary forests not identified as such) or errors of commission (managed forests identified as being primary

forests). Nevertheless, the term "primary forest" as defined by the FAO and in the *RED* is not utilized in the context of Canada's own regulations, and is not reported as such in provincial or federal land and forest inventories.

On the other hand, for the purpose of carbon accounting and reporting, Canadian forests are categorized into "managed" versus "unmanaged". Under the United Nations Framework Convention on Climate Change (UNFCCC), Canada must report annually on GHG emissions and removals from the managed forest, which represents a subset of the total forest area in Canada. The Intergovernmental Panel on Climate Change (IPCC) defines forest management as "the process of planning and implementing practices for stewardship and use of the forest aimed at fulfilling relevant ecological, economic and social functions of the forest in a sustainable manner." The IPCC instructs that the definition of forest management at the national level should be applied consistently over time and cover all forests subject to periodic or ongoing human interventions, including the full range of management practices from commercial timber production to stewardship for non-commercial purposes.

In collaboration with the provinces, Canada has chosen to take an area-based approach to defining the managed forest, whereby a set of criteria are used to define the boundaries within which all forest lands are considered to be part of the managed forest by virtue of the systems of practices in that area (or that have been in that area since 1990). The exact definition of managed forest varies from province to province. For example, in BC, the whole provincial forest landbase is considered to be part of the managed forest. In Ontario, the managed forest corresponds to the boundaries of fire management zones, and is therefore under some sort of fire management, reporting and/or protection activity. In Quebec, the managed forest is the area located south of the northern limit for timber allocations (MRN 2012b). This limit has been defined in 2003 based on economic, management and environmental protection reasons (MRN 2000). The forests located above this limit (nearly 24 million ha or 43% of the forested boreal forest of Quebec; MRNF 2008b) are not a protected area *per se* since other activities, such as mining, may be undertaken. A multidisciplinary scientific committee is currently drafting recommendations to specify new parameters and redefine the northern limit based on improved knowledge about northern forests and SFM (MRN 2012b). Therefore, it can be seen that the managed forest is not equivalent to a forest area that has been, or is planned to be, actively managed for timber production; on the other side, the unmanaged forest is not meant to reflect a primary, virgin or protection status.

Areas designated for nature protection purposes

Federal government

Protected areas are lands and waters where development and use is restricted by governmental legal means or agreements for the conservation of nature (Environment Canada 2012a). Canada recognizes the IUCN's definition of protected areas (IUCN 2012; see Box 1 for details). Within the federal government, some ministries have the mandate to protect significant habitats under federal jurisdictions.

As a signatory to the Convention on Biological Diversity, Canada is contributing to the target of protecting 17% of the Canadian global terrestrial area by 2020 (Environment Canada 2012a). The federal government also manages the implementation of international protected areas programs in Canada, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Sites, Biosphere Reserves and Ramsar wetlands sites (Environment Canada 2013). Moreover, Environment Canada reports on

Canada's protected areas to the Convention on Biological Diversity, the IUCN's World Commission on Protected Areas and the Organisation for Economic Cooperation and Development (OECD) (Environment Canada 2013).

Table 3. Canadian federal protected areas policies

Protected area	Establishment and management	Legislation	Area (ha)	Objective
National wildlife areas	Environment Canada	*Canada wildlife Act* (Minister of Justice 1995)	1 M	Wildlife conservation, research and interpretation
Migratory bird sanctuary		*Migratory birds convention Act* (Minister of Justice 1994c)	11.5 M	Conservation of habitats to protect migratory birds
National park	Parks Canada	*National parks Act* (Minister of Justice 2000)	22.5 M	Protect and present outstanding representative examples of natural landscapes and natural phenomena that occur in Canada

Provincial governments

Each province also has its own mix of laws and regulations pertaining to protected areas, with the aim of protecting natural and cultural heritage, maintaining biodiversity and providing opportunities for outdoor recreation, education and scientific study opportunities. Some areas may be chosen as representative sections of the Canadian landscape, while others may be created to conserve unique or ecologically sensitive areas or endangered wildlife species. While all protected areas are managed to conserve nature, a proportion of them does not lie in "strictly protected" categories (Environment Canada 2012a): these areas are focused on preserving landscapes where human use has produced landscapes with natural and cultural features that are important or essential for maintaining sustainable use of natural resources.

Table 4. British Columbia (BC) protected areas policies

Protected area	Authority	Legislation	Area (ha)	Objective
Class A park	BC Parks – BC Ministry of Environment	- *Park Act* (Statutes of British Columbia 1996e) - *Protected areas of British Columbia Act* (Statutes of British Columbia 2000)	10 M	Preservation of the natural environment for the inspiration, use and enjoyment of the public
Class B park			3 778	Same as Class A, and may permit a broader range of activities and uses provided that such uses are not detrimental to the recreational values of the park
Class C park			495	Preservation of the natural environment for the inspiration, use and enjoyment of the public
Recreation area			5 933	Public recreation use
Conservancy			2 M	(a) for the protection and maintenance of their biological diversity and natural environments, (b) for the preservation and maintenance of social, ceremonial and cultural uses of first nations, (c) for protection and maintenance of their recreational values, and (d) to ensure

				that development or use of their natural resources occurs in a sustainable manner consistent with the purposes of paragraphs (a), (b) and (c).
Designation under the *Environment and land use Act*		*Environment and land use Act* (Statutes of British Columbia 1996b)	383 332	To ensure that all aspects of the preservation and maintenance of the natural environment are fully considered in the administration of land use and resource development
Ecological reserve[1]		*Ecological reserve Act* (Statutes of British Columbia 1996a)	160 424	To reserve Crown land for ecological purposes and protect natural features
1. One ecological reserve is also included a Class A park. The area of overlap is approximately 10 hectares. Two ecological reserves are also included in Lac du Bois Grasslands Park established under the *Environment and land use Act*. The area of overlap is 270 hectares.				

Table 5. Ontario protected areas policies

Protected area	Authority	Legislation	Area (ha)	Objective
Provincial park: nature reserve class	Ontario Ministry of Natural Resources	*Provincial parks and conservation reserves Act* (Statutes of Ontario 2006)	117 935	Protect representative ecosystems and provincially significant elements of Ontario's natural heritage, including distinctive natural habitats and landforms, for their intrinsic value, to support scientific research and to maintain biodiversity.
Conservation reserve		*Provincial parks and conservation reserves Act* (Statutes of Ontario 2006)	1 M	Protect representative ecosystems, biodiversity and important elements of Ontario's natural and cultural heritage.

Highly biodiverse grasslands

Grassland ecosystems are found mostly in Canada's prairie provinces (Alberta, Saskatchewan and Manitoba; Riley et al. 2007; Bailey et al. 2010). The *Grasslands National Park,* located in Saskatchewan, is the only national prairie park (Parks Canada 2012a). This *National park* was established to conserve and protect a portion of this Canada's mixed-grass prairie (Parks Canada 2010). Smaller areas of grassland ecosystems are also scattered across the country, especially through southern Ontario, the dry eastern side of British Columbia's north-south mountain ranges and the Yukon (Shorthouse 2010). Significant parts of these grasslands are formally protected by law as protected areas (Section 1.2.1.2). For example, a humid grassland ecosystem type is protected in the *Marcel-Raymond Ecological Reserve* of the province of Quebec (MDDEFP 2002). Forestry activities are generally not permitted in these protected areas.

Table 6. Quebec protected areas policies

Protected area	Authority	Legislation	Area (ha)	Objective
Exceptional forest ecosystem[1] (EFE)	MRN[2]	– *Sustainable forest development Act* (Statutes of Quebec 2010) – *Act respecting threatened or vulnerable species* (Statutes of Quebec 1989)	32 498	Protection of ecosystems that have a special interest for the conservation of biological diversity, because of their scarcity or age.
Habitat of a threatened or vulnerable plant species	MDDEFP[3]	– *Act respecting threatened or vulnerable species* (Statutes of Quebec 1989) – *Regulation respecting threatened or vulnerable wildlife plant species and their habitats* (Statutes of Quebec 2005)	5 063	Protection and management of designated threatened or vulnerable (TOV) plant species or of plant species likely to be so designated.
Wildlife habitat[4]	MDDEFP	– *Act respecting the conservation and development of wildlife* (Statutes of Quebec 1983) – *Regulation respecting wildlife habitats* (Statutes of Quebec 2009)	703 336	Habitat protection of species that accomplish an important vital cycle in these habitats.
Wildlife preserve	MDDEFP		16960	Conservation of wildlife and its habitat, their development in keeping with the principle of sustainable development, and the recognition of every person's right to hunt, fish and trap in accordance with the law.
Quebec's national park	MDDEFP	*Parks Act* (Statutes of Quebec 1977) *Parks regulation* (Statutes of Quebec 2000)	1 108 175	Conservation and permanent protection of areas representative of the natural regions of Quebec and of natural sites with outstanding features, in particular because of their biological diversity, while providing the public with access to those areas or sites for educational or cross-country recreation purposes.
Quebec's national park reserve	MDDEFP		3 002 365	Conservation of areas for which a legal status is in process (forestry, mining and energy uses are prohibited).
Aquatic reserve	MDDEFP	*Natural heritage conservation Act* (Statutes of Quebec 2002)	219	Protect all or part of a body of water or watercourse, including associated wetlands, because of the exceptional value it holds from a scientific, biodiversity-based viewpoint, or to conserve the diversity of its biocenoses or biotopes.
Biodiversity reserve	MDDEFP		228 616	Maintain biodiversity and, in particular, an area established to preserve a natural monument (a physical formation or group of formations) and an area established as a representative sample of the biological diversity of the various natural regions of Québec.
Ecological reserve	MDDEFP		96 169	(1) to conserve the elements constituting biological diversity in their natural state, as integrally as possible and in a permanent manner, in particular by protecting ecosystems and the elements or processes on which their dynamics are based; (2) to set aside land for scientific study or educational purposes; or (3) to safeguard the habitats of threatened or vulnerable species of flora or fauna.
Recognized nature reserve	MDDEFP and other		12 884	Land under private ownership recognized as a nature reserve because it has significant biological, ecological, wildlife, floristic, geological, geomorphic or landscape features

	institutions			that warrant preservation.
Man-made landscape	MDDEFP		n.a.	To protect the biodiversity of an inhabited area of water or land whose landscape and natural features have been shaped over time by human activities in harmony with nature and present outstanding intrinsic qualities the conservation of which depends to a large extent on the continuation of the practices that originally shaped them.
Nature reserve on private property	MDDEFP, McGill University		11000	Conservation of an area because of its significant biological, ecological, wildlife, floristic, geological or landscape features that warrant preservation.
Wildlife refuge	MDDEFP		2 266	Preserve integrity of a wildlife refuge because of its productivity, density, diversity or if it shelters rare, TOV species.
Experimental and teaching forests	MRN	*Sustainable forest development Act* (Statutes of Quebec 2010)	n.a.	Scientific research and teaching.
Salmon river	MRN		1955732	To protect the riparian zone on each side of any river or part of any river identified as a salmon river.
Biological refuge	MRN		376 933	Protect certain mature or overmature forests that are representative of Quebec's forest heritage.
Northern limit for forest harvesting	MRN		24 M ha	Prohibit forest harvesting in the area located over this northern limit.

[1] 3 types of EFE: Old-growth forest, Rare forest or shelter forest.
[2] MRN (Ministère des Ressources naturelles): Minister of Natural Resources.
[3] MDDEFP (Ministère du Développement durable, Environnement, Faune et Parcs): Minister of Sustainable Development, Environment, Fauna and Parks.
[4] 11 types of wildlife habitat: Water fowl gathering area, White-tailed deer yard, Area frequented by caribou south of the 52º parallel, Caribou calving area north of the 52º parallel, Cliff inhabited by a colony of birds, Habitat of a threatened or vulnerable wildlife species, Fish habitat, Muskrat habitat, Heronry, Island or peninsula inhabited by a colony of birds and Salt lick.

Wetlands and peatlands
Federal

With about 127 million ha (NRCAN 2010) of wetlands (14% of the land surface), Canada is estimated to incorporate up to one-quarter of the world's wetland area (Environment Canada 2012b). Canada signed the *Ramsar Convention* in 1981 (Ramsar 2004). To fulfill its commitment to this convention, Canada adopted the *Federal policy on wetland conservation* in 1991 (Government of Canada 1991; Table 7), becoming the first country to develop a policy for conserving wetlands. This policy is based on the National Wetlands Working Group's wetland definition, "land where the water table is at, near, or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water tolerant vegetation" (National Wetlands Working Group 1987; 1988). There are five types of wetlands according to vegetation physiognomy: bogs, fens, swamps, marshes, and shallow open waters (National Wetlands Working Group 1997). Of these, bogs and fens are classified as peatlands (Government of Canada 1991). Peat thickness must reach at least 40 centimeters (Canada Soil Survey Committee 1978; National Wetlands Working Group 1997). Peatlands occupy about 1100 million ha, which represent 85% of the total area of wetlands in Canada (Environment Canada 2012b). Approximately 12% of the Canadian landmass is covered with peatlands.

Environment Canada is responsible for coordinating the implementation of the *Federal policy on wetland conservation*, especially through the *Implementation guide for federal land managers* (Lynch-Stewart et al. 1996). Although the Policy is not a regulatory document, the federal Cabinet directed that it should be applied to policies, plans, programs, projects and activities carried out by the federal government, thus in areas of federal jurisdiction. The Policy outlines strategies for the use and management of wetlands so that they can continue to provide a broad range of functions on a sustainable basis (Government of Canada 1991). One of these strategies supports and promotes the *Canadian wetland inventory* (DUC 2013a), a nationally standardized approach for wetland inventories and a monitoring of wetland trends and quality according to guidelines for wetland conservation. This inventory provides digitally mapped and classified wetlands using standardized data structure and management protocols (DUC 2013b). This inventory only applies to federal land, and does not have a strict legal value. However, other legal tools can be used to enforce protection of wetlands (Table 7).

Only 29% of all wetlands in Canada are found on federal lands (Tarnocai 1984). The laws pertaining to the operation and management of most wetlands are under provincial jurisdiction (Poulin et al. 2004). Despite this jurisdictional separation of responsibilities, all levels of government directly cooperate in shared wetland management initiatives such as the *North American waterfowl management plan* (NAWMP 2012). Most of the 13 provincial and territorial jurisdictions adopted complementary policy and legislative initiatives (Rubec & Hanson 2009).

In addition to participating to the *Ramsar Convention* and the *North American waterfowl management plan*, the Government of Canada has acceded to the *United Nations (UN) Convention on Biological Diversity* (UN 1992a), which assures wetland conservation (CBD 2013), and the *UN Conference on Environment and Development-Agenda 21* (UN 1992b), which identifies wetland conservation as a priority (UN 1992b; Ramsar 2013b).

Table 7. Canadian federal wetland conservation policies

Main policies	Policy	Authority	Application and comments
Federal policy on wetland conservation (Government of Canada 1991)	To sustain the ecological (water recharge, habitats, etc.) and socio-economic (hunting, trapping, agriculture, etc.) functions of wetlands, now and in the future. Aims at no net loss of wetland functions on all federal lands (29% of Canadian wetlands). Includes peatlands (account for 88% of Canadian wetlands).	Environment Canada	All wetlands
Fisheries Act (Minister of Justice 1985b)	Protects wetlands by prohibiting alteration, disruption or destruction of fish habitat and deposition of harmful substances in fish habitat.	Department of Fisheries and Oceans	Applies to all fishing zones, territorial seas and inland waters of Canada and is binding to federal, provincial and territorial governments. As federal legislation, the *Fisheries Act* supersedes provincial legislation when the two conflict. Note: On June 29, 2012, the *Fisheries Act* was amended. Policy and regulations are now being developed to support the new fisheries protection provisions of the Act (which are not yet in force). The existing guidance and policies continue to apply.
Migratory birds convention Act (Minister of Justice 1994c)	Protects wetlands by prohibiting deposition of harmful substances in areas frequented by migratory birds.	Environment Canada	Applies in Canada and in the exclusive economic zone of Canada.
Species at risk Act (Minister of Justice 2002)	Protects wetlands by prohibiting damage or destruction of the habitat of an endangered or threatened species.	Environment Canada	Applies to projects that occur in the vicinity of, or have the potential to impact, species at risk and their associated habitats, on public and private land.
Canadian environmental assessment Act (Minister of Justice 2012a)	Protects the components of the environment within the legislative authority of Parliament from significant adverse environmental effects caused by a project, and ensures that projects that involve a federal authority under any Act of Parliament are considered in a careful and precautionary manner to avoid significant adverse environmental effects. Regulations associated with this Act develop some paragraphs (e.g. Regulations designating physical activities (Minister of Justice 2012b) and Comprehensive study list regulations (Minister of Justice 1994a), that prohibit water projects and physical activities on wetlands). These regulations define: - Wetland as a swamp, marsh, bog, fen or other land that is covered by water during at least three consecutive months of the year. - Water body as a canal, reservoir, ocean and wetland, up to the high-water mark.	Canadian Environmental Assessment Agency, National Energy Board, Canadian Nuclear Safety Commission, Environment Canada	Applies to projects described in the *Regulations designating physical activities*, and to projects designated by the Minister of the Environment.

British Columbia

Wetlands comprise approximately 5.6%, or 5.28 million ha, of BC (Ministry of Environment 2011). The majority of peatlands are located in the northeastern portion of the province (Wetland Stewardship Partnership 2010b).

Although there are multiple initiatives in BC to address wetland conservation, there is no over-arching provincial direction or policy on wetland protection to address all land uses and development pressures. There has been recent progress towards developing a comprehensive province-wide effort on wetland conservation. In 2008, the BC Ministry of Environment published interim guidelines for wetland protection and conservation, including guidelines that specifically address forestry operations (BC Ministry of Environment 2008). In 2010, the *Wetland stewardship partnership* was formed by several organizations and government agencies, with the intention to develop a comprehensive *Wetland action plan* to protect BC's wetlands and to be implemented through interagency cooperation (Wetland Stewardship Partnership 2010b).

The *Forest and range practices Act* (Statutes of British Columbia 2002) and *Forest planning and practices regulation* (Statutes of British Columbia 2004a) specifically address wetland protection in the context of forest management operations on public land. Planning for wetland protection is a mandatory component of *Forest stewardship plans* (see Table 11).

A wetland identification guide was published by the province in 2004, providing descriptions of wetlands present in BC and ecologically-based recommendations for wetland management (MacKenzie & Moran 2004). Wetland management recommendations, best management practices, and risk factors are provided in the context of forest management for commercial timber production; only wetlands that can support the traditional forest products market (not including bioenergy feedstocks) are addressed by the 'forestry' section of the guide. This guide is thorough in its description and assessment of wetland types, but does not fully address the new harvest demands of the bioenergy market, nor does it provide binding forest management operations standards for wetlands (MacKenzie & Moran 2004).

Forest management operations in wetlands are sometimes restricted by the silvicultural guidelines provided by the province. These guidelines are meant for interpretation by local experts based on specific sites and conditions. Once they are interpreted, and subsequently included in a provincially-approved Forest stewardship plan, they must be followed. There is therefore a system to determine forest management practices on wetlands based on the ecology of these areas in BC, despite there not being a policy to ensure their outright protection.

Table 8. BC wetland conservation policies

Main policies	Policy	Authority	Application and comments
Wetland action plan (Wetland Stewardship Partnership 2010)	None. Sets goals for policy and wetland conservation efforts and specific methods to reform wetland conservation in BC.	Multi-agency group[1]	The 2010 Plan is "to be implemented cooperatively by governmental and non-governmental organizations in order to protect British Columbia's remaining natural wetlands, and to restore important wetlands that have been severely damaged". No major policy changes have been implemented yet as a result of the Action Plan.
Forest planning and	Riparian management area established for forest	BC Ministry of Forests,	Applies to all forest management activities on publicly owned land.

practices regulation (Statutes of British Columbia 2004a)	management activities in and around wetlands of 1ha in size (>0.25ha in some biogeoclimatic zones). Provides restrictions on management activities based on the objective set by government for water, fish, wildlife and biodiversity within riparian areas; that is, without unduly reducing the supply of timber from British Columbia's forests, to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas.	Lands and Natural Resource Operations	
Wetlands of British Columbia: a guide to identification (MacKenzie & Moran 2004)	Wetland management recommendations, best management practices, and risk factors are provided in the context of forest management for commercial timber production. None are mandatory.	BC Ministry of Forests	– Applies to all forest management activities on publicly owned land. – Recommendations are made for traditional commercial forest products industry, and may not represent the unique demands of a bioenergy industry.
Regional silvicultural guides	Forest management operations in peatlands are restricted by silvicultural guidelines, based on BC's biogeoclimatic ecosystem classification system. Restrictions on forest management include, e.g., recommendations to avoid logging or disturbance in areas with ≥ 30 cm deep peat layer.	BC Ministry of Forests, Lands and Natural Resource Operations	– Applies to all forest management activities on publicly owned land. – Restrictions are not mandatory, but must be considered in forest management planning. Permanent site damage, or failure to return site to pre-disturbance conditions, is not allowed.

[1] Government agencies: Environment Canada, BC Ministry of Environment, BC Ministry of Forests and Range, BC Ministry of Healthy Living and Sport, BC Hydro, The Union of BC Municipalities.
Non-profit organizations and research institutions: The Nature Conservancy of Canada, BC Wildlife Federation, BC Nature (The Federation of BC Naturalists), The Grasslands Conservation Council of British Columbia, The Nature Trust of British Columbia, The Pacific Salmon Foundation, Ducks Unlimited Canada, Royal Roads University.

Ontario

Ontario contains approximately 23 to 29 million ha of wetlands, which account for 25% of Canada's wetlands and 6% of global wetlands. The majority of wetlands in Ontario are located in the north. Nearly 10 million ha of these peatlands, or 42 billion tonnes of peat (at 50% moisture content) occur below the permafrost line (Riley & Michaud 1994). The primary location of peatlands in Ontario is the Hudson Bay Lowlands, a region located almost entirely outside the region within which forest management activities are permitted (Gleeson et al. 2006; OMNR 2012). There are notable regions containing peatlands elsewhere in the province, particularly the central Ontario Clay Belt and the hardwood bogs and fens of southern Ontario (Riley 1994).

Conversion of wetlands to other land uses was prevalent in the past, and by the 1980's, 68% of wetlands in the densely populated area of southern Ontario had been converted (OMNR n.d.). The protection of Ontario's wetlands (Table 9) has been strengthened by recent changes to provincial policies, regulations, and legislation, including the 2005 *Provincial policy statement* (OMMAH 2005), the *Conservation authorities Act* (Statutes of Ontario 1990b) and its associated regulations (OMNR 2012).

Provincially significant wetlands such as those described in the *Provincial policy statement* (OMMAH 2005) are identified through the science-based ranking system called the *Ontario wetland evaluation system* (OMNR n.d.). This evaluation system provides a standardized method of assessing wetland functions and societal values, which enables the province to rank wetlands relative to one another. The evaluations are revisited periodically in order to update the status of wetlands, due to the dynamic nature of wetlands themselves, for example through changes to the status of species, confirmation of new species occurrences, wetland boundary modifications, changes to the social values of the wetland, or changes in local development and land use conversion pressures.

Specifically in regards to forest management activities, the *Ontario forest management guide for conserving biodiversity at the stand and site scales* (OMNR 2010) addresses wetland protection during forest management planning and harvest activities. This *Stand and site guide* recognizes that forest management operations within, or adjacent to, wetlands can affect the composition, structure, and function of wetlands, including their physical and chemical properties (OMNR 2010). The Guide provides standards, guidelines, and best management practices to be followed when working in and around *Provincially significant wetlands*, and delineates an *Area of concern* surrounding them where these restrictions on activity apply. Standards are to be followed as law, while guidelines are to be interpreted and applied based on local expert knowledge and site conditions. Best management practices are recommendations that are to be taken into consideration when writing a forest management plan (see Table 12); once included in an forest management plan, guidelines and best management practices are legally binding (OMNR 2010).

Other than the *Stand and site guide*, there are regional silvicultural manuals for Ontario's forests that provide direction for operations within forested wetlands. However, for locally uncommon wetland types not addressed in detail by the silvicultural guides, the *Stand and site guide* direction is designed to mitigate potential detrimental impacts of forest operations in these sites (OMNR 2010).

There is no policy in place to ensure peatland protection during forest management planning and operations, though wetland protection policies do include protection measures for *Provincially significant wetlands*, including some peatlands. It is unclear to what extent forest management operations directly impact peatlands, for example through timber harvest or road building, though timber harvest operations on peatlands are frequent in certain regions (Riley 1994). In central Ontario, it is estimated that "production black spruce forest" on peatlands occurs on 38% of regional peatlands (Riley 1994). Specifically within the central Ontario Clay Belt region, most harvested wood originates in peatlands (Jeglum et al. 1982), and forestry is the most prevalent use of peatlands (Riley 1994). There are major research efforts being undertaken to determine the peatland site classification, harvesting systems and their impacts on peatlands, site preparation and regeneration, and how to integrate harvesting and regeneration operations (Riley 1994).

Table 9. Ontario wetland conservation policies

Main policies	Policy	Authority	Application and comments
Provincial policy statement on natural heritage (OMMAH 2005)	Prohibits development and site alteration, including forest management, in *Provincially significant wetlands* (PSWs) of southeastern Ontario. Prohibits development and site alteration of PSWs in central and northern Ontario unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions.	Ontario Ministry of Municipal Affairs and Housing	Provincially Significant Wetlands determined by the Ontario Ministry of Natural Resources (OMNR) using the Ontario Wetland Evaluation System, a standardized method of assessing wetland functions and societal values, which enables the province to rank wetlands relative to one another.
Conservation authorities Act (Statutes of Ontario 1990b)	*Conservation authorities* (CAs) have the power to regulate development and activities in or adjacent to wetlands.	Conserva-tion Ontario	CAs regulate areas where development could interfere with the hydrologic function of a wetland, incl. areas within 120 m of PSWs and wetlands > 2 ha in size, and areas within 30 m of wetlands < 2 ha in size, but not including those where development has been approved under the *Planning Act* or other public planning or regulatory process.
Forest management guide for conserving biodiversity at the stand and site scales - Stand and site guide) – regarding wetlands (OMNR 2010)	Provides management standards, guidelines, and *Best management practices* (BMPs) for forest management operations in and around PSWs and non-Provincially Significant wetlands.	OMNR	Applies to all forest management operations on public land in Ontario. Standards are mandatory. Guidelines and BMPs are interpreted by local experts based on specific site conditions. Once included in a provincially-approved forest management plan, guidelines and BMPs are mandatory.
Forest management guide for conserving biodiversity at the stand and site scales (*Stand and site guid*e) – regarding peatlands (a form of wetland) (OMNR 2010)	Non-mandatory recommendation that a peatland with organic layers over 2-m deep, without a "good root mat", should be avoided due to the risk of soil settlement or displacement and impacts on hydrologic flow and ecosystem function. Also states that if wetlands (not peatlands specifically) must be crossed, managers should consider timing crossings during winter when soils are frozen and only creating temporary crossings.	OMNR	BMPs are interpreted by local experts based on specific site conditions. Once included in a provincially-approved forest management plan, BMPs are mandatory.

Quebec

Wetlands in the province of Quebec represent about 12 million ha or 9% of its total surface (Grenier 2013); 11.8 million ha of these can be classified as peatlands (Keys 1992). In this province, no policy has been adopted for preserving wetlands to date, although work has been initiated to develop one. The *Quebec water policy* (Table 10) seeks to develop and implement an action plan for the protection, restoration and development of the banks and littoral zones of lakes and waterways, their floodplains and wetlands. According to the *Act respecting compensation measures for the carrying out of projects affecting wetlands or bodies of water* (Statutes of Quebec 2012), projects affecting any wetland in Quebec are subject to a certificate by the Quebec Ministry of Sustainable Development, Environment, Fauna and Parks (Ministère du Développement durable, Environnement, Faune et Parcs, MDDEFP). A mix of other provincial regulations provides partial or global legal wetland protection (Table 10).

The *Regulation respecting standards of forest management for forests in the public domain* (Statutes of Quebec 1996; See section 1.2.2.1) states that forest activities are not allowed in buffer strips 20-m wide along peat bogs, swamps, marches, lakes and watercourses if the slope is greater than 40%. Several forestry guidelines (e.g., Jetté et al. 1998) and forest *Protection and development objectives* (MRNFP 2005) relate to protection of wetlands and riparian areas in the context of forestry activities. The Sustainable *Forest management strategy* (MRNF 2010b) is the frame of the new forest regime introduced by the *Sustainable forest development Act* (Statutes of Quebec 2010), which came into force on April 1, 2013. One of the priorities of this strategy includes the protection of the integrity and the ecological functions of wetlands (Langevin & Schreiber 2011). Specific requirements are being incorporated in the *Integrated forest development plans* for the period 2013-2018 (MRNF 2012).

Table 10. Quebec wetland conservation policies

Main policies	Policy	Authority	Application and comments
Quebec water policy (Gouvernement du Québec 2002)	Protection, restoration and development of the banks and littoral zones of lakes and waterways, their floodplains and wetlands	MDDEFP[1]	All wetlands
Environment quality Act (Statutes of Quebec 1972)	Standards must be prescribed to respect the quantity and quality of the surface water or groundwater that may be withdrawn or that must be returned to the environment after use and the conditions of such return, the use of the water withdrawn and the preservation of aquatic ecosystems and wetlands (e.g., *Regulation respecting the application of section 32 of the Environment quality Act*)	MDDEFP	All wetlands
Act respecting compensation measures for the carrying out of projects affecting wetlands or bodies of water (Statutes of Quebec 2012)	Defines "wetland" as a pond, marsh, swamp or bog and body of water as a lake or a constant or intermittent watercourse. In the case of an application for authorization according to the *Environment quality Act* for a project affecting a wetland, the MDDEFP may require compensation measures to restore, create, protect or ecologically enhance a wetland, a body of water or a piece of land near a wetland or a body of water.	MDDEFP	All wetlands
Act respecting threatened or vulnerable species (Statutes of Quebec 1989)	Protection of wetlands supporting endangered species	MDDEFP	Wetlands supporting endangered species
Regulation respecting threatened or vulnerable wildlife species and their habitats (Statutes of Quebec 2009)	The habitat of the Western chorus frog corresponds to a "territory consisting of permanent or temporary wetlands and lands used by that amphibian for breeding, feeding, resting or hibernating". This frog is a protected vulnerable wildlife species.	MDDEFP	Wetlands that are habitats of the Western chorus frog
Natural heritage conservation Act (Statutes of Quebec 2002)	Establishes a network of protected areas representative of biodiversity. Among these protected areas, the aquatic reserves are established to protect all or part of a body of water or watercourse, including associated wetlands, because of the exceptional value they hold from a scientific, biodiversity-based viewpoint or because of the diversity of their biocenoses or biotopes.	MDDEFP	Wetlands associated to "aquatic reserves".
Sustainable forest management Act (Statutes of Quebec 2010)	The forest development standards must ensure protection of lakes, watercourses, riparian areas and wetlands	MRN[2]	Wetlands on forests in the domain of the State
Regulation respecting standards of forest	Peatland is not defined in the regulation. The policy mentions: "a holder of a management permit shall	MRN	Banks of peat bogs on

management for forests in the domain of the State (Statutes of Quebec 1996)	preserve a buffer strip 20-m wide along the banks of a peat bog with a pond, a swamp, a marsh, a lake or a permanent watercourse, as measured from the line of the stands adjacent to the riparian ecotone. The holder of a management permit for silvicultural purposes or mining activities is exempted if the opening is not wider than 5 m in the buffer strip.		forests in the domain of the State
Mining Act (Statutes of Quebec 1987)	The holder of a mining right may perform timber harvests for its mining activities (in accordance with the *Sustainable forest development Act*), except in the case of a strip of woodland established for the protection of lakes, watercourses, riparian areas and wetlands by government regulation under section 38 of the *Sustainable forest development Act.*	MRN	All wetlands
[1] MDDEFP (Ministère du Développement durable, Environnement, Faune et Parcs): Minister of Sustainable Development, Environment, Fauna and Parks. [2] MRN (Ministère des Ressources naturelles): Minister of Natural Resources.			

Continuously forested areas and other wooded lands

The Canadian definition of "forest" is an area with the potential to achieve minimum tree crown cover of 25%, a minimum land area of 1 ha, a minimum tree height of 5 m and a minimum width or distance between trunks of 20 m (NRCAN 2013c). This definition is more specific than that provided by *EU RED*; it is suited to describe the Canadian forest resource in an operational or management context. As such, the *EU RED* definition and associated criteria for "continuously forested areas" are applicable to areas defined as "forest" in Canadian forest management policies and regulations.

In all Canadian provincial forest policies, there are mandatory forest renewal requirements (successful natural regeneration or replanting) to prevent land use change due to harvesting (Statutes of Ontario 1994; Statutes of British Columbia 2002; Statutes of Quebec 2010). On public land, deforestation and land use change due to harvesting is not a legally acceptable result of forest management. As a result of these policies, in 2005, deforestation causing land use change impacted less than 0.02% of forests in Canada, approximately 56 000 ha (NRCAN 2008). This land use change occurred due to expansion of agricultural land (53%), development of urban, transportation, and recreation areas (19%), building of forest roads (10%), development of hydroelectric infrastructure (10%) and industry and resource extraction (8%) (NRCAN 2008). Afforestation efforts offset approximately 9 400 ha of this deforestation. Overall, deforestation in Canada accounts for approximately 0.4% of annual global deforestation.

Canada's policies for sustainable forest management and protection of biodiversity

In the following sections, we describe how the criteria for sustainable forest management and protection of biodiversity from Fritsche et al. (2012) (Table 2), which aim to apply within areas subjected to forest biomass procurement practices (within 'go' areas) are addressed in Canada, both at the federal and the provincial level (for the three provinces). Since forest biomass harvesting is not always specifically mentioned in federal and provincial Acts, regulations and manuals, these criteria are occasionally examined in relation to global harvesting activities.

Sustainable forest management

Federal

Although the definition of sustainability is constantly evolving (CCFM 2013b), SFM in Canada means ensuring that forests provide a broad range of goods and services over the long term,

including significant economic and social benefits (NRCAN 2012b). At the federal level, Canada reports on progress toward SFM through the *Criteria and indicators framework* of the CCFM (CCFM 2013a). Currently the CCFM uses a set of six criteria, each of them including 11 indicators, which gives government, industry, researchers and the public a consistent way to define, asses, monitor and report progress in achieving SFM (NRCAN 2013a). Since 1994, the CCFM is also involved with the Montréal Process (The Montréal Process 2013), which established criteria and indicators for the sustainable management of temperate and boreal forests.

Each jurisdiction develops laws, policies and administrative requirements that characterize SFM and determine actions which take place on public and private forest land. The provinces all have a type of Forest Act (e.g., Statutes of Ontario 1994; Statutes of British Columbia 2002; Statutes of Quebec 2010) that generally provide overall objectives for natural resource management on Crown land. Regulations and manuals associated to these Acts provide more operational requirements for forest management plans and sustainability of forest resource management, and define utilization standards. Additional federal and provincial Acts, such as those regulating environmental, plant species and wildlife, may also normalize forestry activities. Other pieces of law, such as the federal *Fertilizers Act* (Minister of Justice 1985a), regulating the importation and sale of fertilizers and supplements, may also apply to the forest sector.

British Columbia

British Columbia has 55 million ha of forest land, which represent about 67% of the province surface area (MFLNRO 2013b). 96% of this forest land is publicly owned. The British Columbia Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) is responsible for establishing the conditions for access and use of the province's forests (NRCAN 2012b; MFLNRO 2013a; Table 11). Forest management legislation, including the *Forest Act* (Statutes of British Columbia 1996c) and *Forest and range practices Act* (FRPA; Statutes of British Columbia 2002) and their regulations, establish the parameters of sustainable forest management that private companies must comply with in order to carry out forest management operations in public forests (MFLNRO 2002; Statutes of British Columbia 2002).

Forestry legislation was overhauled in 2002 with the introduction of FRPA, replacing the *Forest practices code* (Statutes of British Columbia 1996d). However, the *Forest practices code guidebooks* (e.g., Province of British Columbia 1995a; c; 1999a; b) that were part of the *Forest practices code of BC Act* may still be used for guidance. The introduction of the *Forest and range practices Act* created a results-based forest management system, using professional reliance as a foundation. Professional reliance leaves forest managers room to decide the methods they will use to achieve standards that are enshrined in law. As well as monitoring for management violations by practitioners, the province evaluates how successfully the legislation ensures management objectives and standards are achieved, including SFM (Table 11). According to the *Forest and range evaluation program*, sustainable resource management means meeting present needs without compromising the needs of future generations, providing stewardship of forests based on an ethic of respect for the land, and conserving the resource values identified under the *Forest and range practices Act* and its regulations, namely: biodiversity, cultural heritage, soil, water, fish, forage and associated plant communities, timber, recreation, resource features, visual quality, and wildlife (FREP n.d.). Through this system of professional reliance, this Act encourages innovation by skilled resource professionals, and holds industry responsible for environmental outcomes (MFLNRO 2013c). It is mandatory that forest management

operations first be approved by the MFLNRO, in the form of a *Forest stewardship plan* (Table 11), prior to any action being taken on the ground (Statutes of British Columbia 2002).

Since there is no specific biomass policy in BC and no special license for biomass harvesting is required, biomass removal needs to adhere to the *Forest and range practices Act* and its associated regulations. According to this Act and the *Forest planning and practices regulation*, damage to poor or sensitive sites should be minimized (Statutes of British Columbia 2002; 2004a). Site sensitivity to physical damage, nutrient depletion and level of residue removal are considered when removing residues (Delong 2003; Table 12). Site sensitivity assessment dictates best management practices for sites prone to erosion (Green & Klinka 1994). A site sensitivity assessment is based on slope, terrain and compaction (Table 11). While *Forest planning and practices regulation* has indications for allowable soil disturbance (Statutes of British Columbia 2004a), they are not specified for residue removal. On sensitive soils, a maximum of 5% of the area to be reforested may be affected by soil disturbance, while this percentage is 10% where soils are not predominantly sensitive (Table 11). It is a requirement that the productivity and hydrological function of soils is conserved (Statutes of British Columbia 2002; 2004a).

Fertilization is allowed, whereas wood ash is not addressed. Fertilization application is prescribed depending on site conditions (Statutes of British Columbia 2002; 2004a). The *Forest fertilization guidebook* (Province of British Columbia 1995b) assists forestry practitioners in meeting requirements with respect to the safe and efficient application of fertilizer. Forest residues included in the *British Columbia bioenergy Strategy* (MEMPR 2008) refer to those from logging practices, road clearing and other sustainable forestry activities. However, stump harvesting is not addressed by any BC legislation, regulation or policy.

Table 11. British Columbia forest regime

Elements	Current regime
Acts	*Forest and range practices Act* (FRPA; Statutes of British Columbia 2002) *Forest Act* (Statutes of British Columbia 1996c)
Main regulations	*Forest planning and practices regulation* (FPPR; Statutes of British Columbia 2004a) *Forest practices board regulation* (Statutes of British Columbia 2004b) *Forest recreation regulation* (Statutes of British Columbia 2004c) *Range planning and practices regulation* (2004 Statutes of British Columbia 2004a)
Biomass harvesting policy	There is no specific biomass policy and no special license for biomass harvesting is required. Hence, biomass removal adheres to the *FRPA* and its associated regulations. The *British Columbia Bioenergy Strategy* (MEMPR 2008) sets goals for investing in and developing biofuel production.
Orientations and management frame	*A new direction for strategic land use planning in BC* (2006)
Allocation of wood	– *Forest Act*: sets out the forms of agreement under which Crown timber can be issued to other interests, and describes each form of tenure through aspects like duration, the rights and obligations of the holder, and how the tenure will be administered – Tenures may be volume-based (allowing several licensees under a timber supply area to operate in the same management unit) or area-based (granting a single licensee virtually exclusive rights to harvest timber in a given area). – Tenures may be replaceable (20-25 years in length, updated or replaced every 5-10 years to reflect current policy) or non-replaceable (fixed term, intended to achieve specific goals). – Tenures may be awarded by government through a competitive bid process, or by direct award. – Fifteen types of tenures exist. – Annual allowable cut (AAC), apportionment and commitments: – British Columbia's Chief Forester is required by law to determine how much wood can be harvested sustainably in each of the province's 70 management units. The AAC of each management unit (timber supply areas (TSA) and tree farm licenses (TFL)) is determined by the chief forester, at least once every 5 years. The Chief Forester may specify portions of the AAC to different types of timber and terrain within a management unit; also known as partitions. – The Minister may apportion the AAC of a TSA to the various forms of agreement that may be issued under Section 12 of the *Forest Act*. The Minister, if permitted to do so under a TFL, may make AAC within a TFL available to persons other than the TFL holder. The Minister apportions the AAC in consideration of government objectives for the area, the timber quality, existing commitments and other relevant information. – The apportioned AAC is used to support new and existing tenures (or licenses). Only those licenses with an AAC (TFLs, forest licenses, and replaceable timber sale licenses) are listed in the apportionment system. – AAC apportioned to woodlot licenses (WL) and community forest agreements (CFA) is used to support new WLs and CFAs. Once a new WL or CFL is established, the supporting Crown land and AAC are removed from the source TSA. The apportionment system does not report on issued WLs or CFAs or Forestry Licenses to Cut. – British Columbia Timber Sales (BCTS): founded in 2003 with a mandate to provide the cost and price benchmarks for timber harvested from public land in British Columbia. Through 12 Business Areas and an operational presence in 33 locations, BCTS manages some 20 percent of the provincial Crown allowable annual cut.

	Guided by the overriding principles of safety and sound forest management, BCTS: 1. Is a high performing organization with skilled, motivated and proud people. 2. Provides a credible reference point for costs and pricing of timber harvested from public land in B.C. 3. Provides a reliable supply of timber to the market, through open and competitive auctions – subject to meeting the requirements of cost and price referencing as stated in Goal 2. Maximizes net revenue for the province – subject to the requirements of cost and price referencing as stated in Goal 2 and supplying timber for auction as stated in Goal 3.
Management of forest resources	– Responsible: Tenure holders – *FRPA* and its regulations govern activities including planning, road building, logging, reforestation and grazing. – Under *FRPA*, government can set objectives for sustaining forest values—biodiversity, cultural heritage, forage, fish, recreation, resource features, soils, timber, visual quality, water and wildlife. *FRPA* enables government to set new objectives for localized values including visual quality, lake and stream sides, and recreation values. Ongoing monitoring and enforcement is carried out to ensure objectives are met. – Before conducting any operations, all major timber licensees and BC Timber Sales must complete a Forest stewardship plan (FSP). Woodlot holders must prepare a Woodlot License Plan. These plans must outline how the licensees will address the provincial objectives. – Before submitting a plan to government for approval, licensees must make it available for public review and comment. As well, licensees must make reasonable efforts to discuss the plan with First Nations groups potentially affected. Government must approve the plan if its content meets legal requirements, its results and/or strategies are consistent with government legal objectives, it is consistent with the terms of the tenure, and the decision maker is satisfied regarding the adequacy of public and First Nations consultation. – Once a plan is approved, the licensee must prepare site plans that describe how it will meet government objectives in specific sites where logging, road building or silvicultural activities are proposed. These plans must be available to the public upon request. In most cases, licensees are required to obtain Cutting Permits and Road Permits before work begins. – A number of licensees operate under separate regulations that allow development of alternative forest management approaches, such as those designed to increase timber supply.
Sustainability	– *FRPA* and its regulations: govern the activities of forest and range licensees in B.C. The statute sets the requirements for planning, road building, logging, reforestation, and grazing. – *FRPA* maintains high levels of protection for forest values including watersheds and wildlife habitat, and creates efficiencies for both government and industry through streamlined planning processes. – *FRPA* encourages innovation by skilled resource professionals and holds industry responsible for outcomes. Combined with rigorous compliance and enforcement, the *Act* and regulations will contribute to high quality forest management and sustainable environmental values for future generations. – *FPPR* provides provincial sustainability objectives and specific direction to forest managers to meet these objectives, including for FSP content and requirements for forestry practices (regarding soils, timber and forest health, riparian areas, watersheds, biodiversity, General Wildlife Measures for wildlife protection, roads and road building) – *Government actions regulation* (Statutes of British Columbia 2004d) provides the criteria and processes for the creation of localized areas that require special management of certain forest values. These values include wildlife, fish, water quality, visual quality, stream and lake sides and recreation. The regulation also provides for the creation of objectives for managing these areas. – *Invasive plants regulation* (Statutes of British Columbia 2004e) provides lists of invasive species for consideration in *Forest stewardship plans* and woodlot license plans under *FRPA*.

Ontario

Ontario's forests represent 66% of the province surface area (71 million ha) and about 90% of this forest land is publicly owned (OMNR 2013). Forest management (Table 12) on public land in Ontario is governed by the *Crown forest sustainability Act* (Statutes of Ontario 1994) and its associated regulations. Under this Act, the Ontario government allocates timber for harvest by private companies, which must follow standards of management practices and have their Forest management plans approved by the Ministry of Natural Resources (OMNR) before proceeding with management operations. The recently enacted *Ontario forest tenure modernization Act* (Statutes of Ontario 2011) takes steps to make the forest tenure system more adaptable and responsive to market demands, promotes diversification of forest products, and increases the accessibility of and control over the forest resource to local forest-dependent communities, First Nations, and small-scale companies (Statutes of Ontario 2011). It does so by creating *Local forest management corporations* and *Enhanced sustainable forestry licenses*.

The *Ontario forest tenure modernization Act* modifies the system of timber allocation, shifting this responsibility from the province to the *Local forest management corporation boards* and *Enhanced sustainable forestry licenses companies*. These *Local forest management corporations* are Crown agencies governed by a predominantly local board of directors responsible for managing Crown forests and overseeing the marketing and sale of timber in a given area. They are responsible for forest management, selling and marketing timber, and negotiating the price of wood. Mills do not control the wood supply, as they did previously. This governance structure is intended to empower communities to determine their future, and is focused on providing benefits to local and Aboriginal communities. *Enhanced sustainable forestry licenses* are companies that may be owned by, for example, the consuming mills and/or harvesters, or a non-profit corporation, and operate in a manner that will achieve the previously mentioned objectives of tenure modernization. SFM remains a cornerstone of this updated legislation (Statutes of Ontario 2011).

Biomass harvest must be planned through the regular forest harvesting processes. Moreover, the *Forest biofibre policy direction* (OMNR 2008) is a guiding policy that defines the appropriate and acceptable fibre sources that are not utilized and provides general direction for the allocation and use of biomass. According to this policy, forest biofibre is defined as "forest resources from Crown forests that are not normally being utilized for conventional forest products and that are made available under an approved management plan". One section of the *Stand and site guide* (OMNR 2010) offers standards and guidelines for forest biomass harvesting. Hence, residue removal in areas with nutrient depletion risks is regulated according to the conventional *Forest management plans* (OMNR 2010).

A fertilization project should seek *Environmental assessment Act* (Statutes of Ontario 1990c) coverage. Stumps and roots are not used as a forest product (OMNR 2010). While there are best management practices for high erosion risk areas (OMNR 2010), there is no mandatory standard in place. There are no specifications on residue removal from soils with low to medium disturbance risk. However, the *Stand and site guide* (OMNR 2010) suggests strategies and techniques to minimize soil disturbance during harvesting, renewal and tending operations. As stated by the same guide, organic matter that is not part of a harvested tree should remain on site.

Table 12. Ontario forest regime

Elements	Regime until 2011	New regime beginning in 2011
Acts	*Forestry Act* (Statutes of Ontario 1990d)	*Crown Forest Sustainability Act*

	Crown Forest Sustainability Act (CFSA; Statutes of Ontario 1994)	(CFSA) (Statutes of Ontario 1994) *Ontario Forest Tenure Modernization Act* (Statutes of Ontario 2011) – amends CFSA to allow for creation of LFMCs and eSFLs (see "Allocation of Wood")
Main regulations	*Ontario Regulation 167/95 General* *Ontario Regulation 160/04 Independent Forest Audits*	
Biomass harvesting policy	Biomass harvesting must be planned through the regular forest harvesting processes (CFSA and associated regulations, manuals and guides). The Forest biofibre policy direction (OMNR 2008) provides guiding for appropriate non-utilized fibre sources and allocation and use of biomass. The Stand and site guide provides available standards and guidelines for forest biomass harvesting (OMNR 2010).	
Orientations and management frame	*Policy framework for sustainable forests* (OMNR 1994): To ensure the long-term health of our forest ecosystems for the benefit of the local and global environments, while enabling present and future generations to meet their material and social needs.	
Allocation of wood	– Supply Agreement: The Crown makes a specific supply of Crown forest resources available to a licensed forest resource processing facility (mill) for a specified period of time. They normally make wood supply available from one or more specified management units. – A supply agreement obligates the holder of a forest resource license (a harvester) to make forest resources available to the holder of a supply agreement (mill operator). These commitments usually require that the harvester and mill operator establish a mutually beneficial business arrangement that will facilitate the flow of forest resources from the forest to the mill. – The process to acquire an allocation through a supply agreement follows a rigorous framework that generally requires Cabinet approval before execution. A supply agreement can be granted: 1. In accordance with a competitive process described in *CFSA*, Section 24. This is the most common manner in which supply agreements are granted; or 2. The Minister can make forest resources available without a competitive process under certain limited circumstances in accordance with *Order in Council 993/95*. Generally, the exceptions to a competitive process can be made for the following reasons: a. to meet an existing legal commitment b. to meet the approved utilization levels of existing forest industry c. to satisfy economic opportunities for Aboriginal people – Allocation of wood for harvest: <u>1. Sustainable forest licenses (SFLs)</u> – Allocation of wood for harvest: SFLs, granted under Section 26 of the CFSA, are long-term licenses issued for a period of 20 years for a defined management area (management unit). SFLs give the holder of the license the right to harvest and use the forest resources available on a management unit and the SFL holder is required to carry out certain forest management activities to provide for the sustainability of Crown forests in the area covered by the license. Forest management activities undertaken by the SFL holder include strategic forest planning, planning and	– AAC for management units and local forests is established *by Local forest management corporations* (LFMCs) and *Enhanced sustainable forestry licenses* (eSFLs) – LFMCs - Crown agencies governed by a predominantly local board of directors responsible for managing Crown forests and overseeing the marketing and sale of timber in a given area. – eSFLs - Companies that may be owned by, for example, the consuming mills and/or harvesters, or a not for profit corporation, and operate in a manner that will achieve the objectives of tenure modernization. – Objectives of tenure modernization are to optimize values derived from Crown forests, and recognize heightened interest of those who live in and near Crown forests (many Aboriginal and forest-dependent communities), and be transparent, flexible, responsive, open, and accountable to the people of Ontario. – LFMCs - responsible for forest management, selling and marketing timber, and negotiating the price of wood. Mills do not control wood supply. Governance

	implementation of operational activities (e.g. access, harvesting, renewal and maintenance), and compliance monitoring of the operational activities. – Some SFLs are held by corporations that operate a large forest processing facility such as a pulp mill and/or sawmill. These are commonly referred to as "single entity SFLs". Ontario also has several cooperative or shareholder style SFLs where several companies interested in Crown timber from a defined geographic area formed a new company to hold the license. SFLs are granted by the Minister of Natural Resources. <u>2. Forest resource licenses (FRLs)</u> – FRLs, granted under Section 27 of the CFSA, are licenses to harvest timber that cover a smaller geographic area. FRLs are issued for periods of up to five years. These licenses may be granted to harvest timber on the same land area as a SFL; however, unlike an SFL holder, the FRL holder is only responsible to undertake the implementation of operational activities such as harvesting and the associated road construction. The SFL holder retains responsibilities for the forest management and other components. – FRLs issued on the same area as an SFL normally require an agreement between the holder of the SFL and the holder of the FRL (commonly referred to as overlapping agreements). – FRL license holders may enter into agreements with the Minister of Natural Resources for renewal and maintenance activities. – Processing of harvested wood: *Forest resource processing facility licenses* (FRPFL) – Persons intending to operate a mill that will use forest resources from any source must obtain a FRPFL (Mill License). Under the CFSA, all mills consuming more than 1,000 cubic meters of forest resources must have an FRPFL. These licenses provide the right to construct and/or operate a mill but do not provide for an allocation (supply) of forest resources to a mill. Facilities are licensed subject to the requirement to submit a business plan acceptable to the Ministry of Natural Resources. – FRPFL holders are required to complete an Annual Return which allows the Ministry to monitor the capacity of forest industry facilities and forest resource utilization. This information is a vital tool to assist in the support and promotion of a healthy forest industry in Ontario, especially when available forest resource supplies change. Provision of accurate information is vital for analysis of forest industry utilization trends, wood flow patterns and the products manufactured from the supply of forest resources. – Allowable Annual Cut (AAC) is established by mill owners (forest managers) under *Shareholder sustainable forest licenses* (SFLs) (single license applicable to many companies and small mills) or *Single entity* SFLs (single license applicable to one company and its mills). – AAC is an area-based value (hectares). – *Forest management plan* (FMP) applies to a *Forest management unit* (FMU) under an SFL: 1. Written according to *Forest management planning manual* (FMPM) 2. Ten-year planning period, with two five-year operational terms, and a twenty-year planning	structure empowers communities to determine their future, and is focused on providing benefits to local and Aboriginal communities.

	horizon 3. Approved by a *Registered professional forester* (RPF) 4. Developed through consultation with RPF, public consultation with local stakeholders, and Aboriginal involvement. 5. Must be approved by Ministry of Natural Resources (MNR) Regional Director 6. Assessed following year seven to see if the plan provided for the sustainability of the Crown forest, recommendations for future planning are provided. 7. A new forest management plan prepared considering the recommendations from the year seven report, changes to the forest condition, updates to science and policy, and specific efforts to confirm, update, or revise management objectives and practices (adaptive management).	
Management of forest resources	– Responsible: SFL and FRL holders – FMPs for each FMU: 1. The forest management plan provides for the long-term Crown forest health on the management unit, and has had regard for plant life, animal life, water, soil, air, and social and economic values, including recreational values and heritage values. 2. FMPs are based on the key elements of sustainability, public involvement, Aboriginal involvement, and adaptive management. – Forest industry is responsible for forest management, planning, renewal, and associated costs; government is a regulator.	– Responsible: LFMC board, or eSFL company – Objective remains sustainable forest management – Responsible entity is in charge of forest management, planning, renewal, and associated costs; government remains a regulator.
Sustainability	– The CFSA includes a commitment to provide for the sustainability of Crown forests and, in accordance with that objective, to manage Crown forests to meet social, economic and environmental needs of present and future generations. – FMPM: Prescribes the requirements for Ontario's forest management planning system including a detailed description of the planning process and the products. – *Forest operations and silviculture manual* (FOSM): provides guidance and direction for the conduct of operations authorized by approved forest management plans. This manual provides for the qualification of persons engaged in forest operations as well as measures for assessing the performance of forest operations. – Forest management is governed by a series of guides that outline silvicultural practices and methods to conserve biodiversity and enhance or protect wildlife habitat, aesthetics, watersheds and other values. These include: – Forest Management *Guide for conserving biodiversity at the stand and site scales (Stand and Site Guide)*: 1. Standards, guidelines, and recommended *Best management practices* (BMPs) for use by forest managers when planning and implementing operations involving harvest, renewal, tending, or the construction and use of roads and landings on crown land in Ontario. Its objective is to contribute to the sustainable management of Crown forests through the maintenance of their long term health. A key aspect of this objective is the conservation of biodiversity. 2. Standards: must be followed as written. Guidelines: mandatory, but require professional expertise and local knowledge to be interpreted and applied. BMPs: not mandatory. Examples of practices one may use to achieve objectives associated with standards or guidelines. 3. Addresses conservation issues at fine (site) and coarse (landscape) levels Other Forest management guides (e.g., *Guide for Great Lakes-St. Lawrence landscapes*) and guides addressing operational, environmental and social topics and values, including resource-based tourism values and cultural heritage values (e.g., *Forest management guide for cultural heritage values*).	

Quebec

Quebec forests cover 76 million ha and represent about 50% of the total province area. 89% of this forest land is publicly owned (MRN 2013). The Ministry of Natural Resources (Ministère des ressources naturelles, MRN) is responsible for managing, protecting and developing public forests in a sustainable manner (Table 13). Until April 1, 2013, forest activities in Quebec were regulated by the *Forest Act* (Statutes of Quebec 1986). On April 1, 2012, the province adopted the *Sustainable forest development Act* (Statutes of Quebec 2010), which introduced some major changes to the way forests are managed. The Act came into force in its entirety on April 1, 2013, and replaced the current *Forest Act*. The *Regulation respecting standards of forest management for forests in the domain of the State* (Statutes of Quebec 1996) will be replaced by the *Sustainable forest management regulation*, which is in preparation. Through the new Act, the MRN has taken back some of the responsibility for integrated forest planning and forestry development activities in the public forests, including planning, carrying out, monitoring and controlling work in the forests, scaling the wood and allocating forestry rights (Statutes of Quebec 2010). It may either carry out the development activities stipulated in the plans from within the Ministry itself, or commission development companies, including forestry groups, forestry cooperatives and silvicultural contractors, to do the work on its behalf. Moreover, to ensure that development is sustainable, the Minister also relies on contributions from regional conferences of elected officers (MRN 2013). These are required to support the planning process and to carry out certain forest development activities.

Several guides and other documents (MRN 2012a) provide guidance for SFM (e.g., MRNF 2008a; Table 14). Forest biomass harvesting policies are being integrated in the new legislation, which is in preparation. Currently, volumes of biomass allocated in conformity with the *Forest biomass allocation program for public lands* must be included in the *Integrated forest development plans* (MRNF 2009a). These plans specify wood allocation, management strategies and goals for sustainable forest development for each development unit (Table x). They are aligned with a tactical plan and an operational plan drawn up by the Minister (Statutes of Quebec 2010). The *Biomass action plan* (MRNF 2009a) set some guidelines for forest biomass harvesting, such as the protection of fragile soils. Moreover, there are considerations for site sensitivity to physical damage, but nutrient depletion risk is not addressed. For example, there is a sensitivity disturbance classification system to reduce rutting (e.g., Schreiber et al. 2006). The *Sustainable forest development Act* (Statutes of Quebec 2010) addresses the conservation of soil and water and the *Regulation respecting standards of forest management for forests in the domain of the State* (Statutes of Quebec 1996) specifies that any cutting without soil protection is prohibited.

Fertilization is addressed by the *Environment quality Act* (Statutes of Quebec 1972), which requires a certificate or authorization from the Minister for all added substance that can cause a change in the quality of the environment. However, in conformity with the *Regulation respecting the application of the Environment quality Act* (Statutes of Quebec 2003), the spreading of manure, mineral fertilizers, logging debris from cutting areas and liming material that meets the standards of the “Bureau de normalization du Québec” used for forest management activities in the domain of the State or in private forests are exempt from this authorization from the Minister (whereas spreading of any other type of substance requires authorization). The *Biomass action plan* (MRNF 2009a) defines forest biomass as “waste products that result from logging and forest management, and inferior quality timber that is not suited for industrial use”. Stumps and roots are excluded from this definition.

Soil disturbance following harvesting has been a priority for the MRN of Quebec. As part of the *Forest protection strategy* (MRNQ 1994), three types of physical soil disturbances have been monitored: rutting, loss of productive land and erosion. Harvesting in areas having more than 40% slope requires a preventive silvicultural prescription (Jetté et al. 1998). The MRN requires that 90% of the harvested areas show little to no rutting (MRNF 2007). To do so, a sensitivity disturbance classification system to reduce rutting (Schreiber et al. 2006) was developed in the context of the *General forest management plan 2008-2013*. According to this system, a slope greater than 40% is considered as a steep slope for rutting risk (Table 14), but sensitivity to risk is not assessed based on this risk only; drainage, texture and surficial deposit thickness and type are also considered. To avoid soil compaction during harvesting, careful logging operations impose evenly spaced trails for circulation of machinery on no more than 25% of the land area (or less than 33% under certain conditions; Statutes of Quebec 1996). Moreover, harvesting is not permitted on soils of poor or very poor drainage (Cauboue 1988) unless soils are frozen to a depth of at least 35 cm (Statutes of Quebec 1996).

Table 13. Quebec forest regime

Elements	Regime until March 31, 2013	New regime beginning April 1, 2013
Acts	*Forest Act* (enacted in 1986 Statutes of Quebec 1986) *Act to amend the Forest Act and other legislative provisions* (National Assembly 2001)	*Sustainable forest development Act* (SFMA; Statutes of Quebec 2010) *Act to amend the Sustainable Forest Development Act and other legislative provisions* (National Assembly 2012)
Main regulations	Regulation respecting standards of forest management for forests in the domain of the State (RSFM; Statutes of Quebec 1996)	*Regulation respecting standards of forest management for forests in the domain of the State* (RSFM; Statutes of Quebec 1996) *Sustainable Forest Management Regulation* (in preparation)
Biomass harvesting policy	The *Forest Act* did not originally permit harvesting of forest biomass from Crown land. Since 2008, *the Forest biomass allocation program* for public lands allowed harvesting of certain volumes of forest biomass in specific management units (MRNF 2009a). This biomass needed to be included in the *Forest management plans*.	There is no specific biomass harvesting policy. The action plan *Developing the value of forest biomass* (MRNF 2009a) set guidelines for forest biomass allocated according to the Forest biomass allocation program for public lands. These volumes must be included within the existing *Integrated forest development plans*.
Orientations and management frame	Forest protection strategy (MRNQ 1994) 1. To ensure respect for the biophysical components of the environment. 2. To maintain forest yields and socio-economic activities. 3. To promote the development and harmonious use of all forest resources. 4. To eliminate chemical pesticide use by the year 2001.	*Sustainable forest management strategy* (in preparation) 1. Take the interests, values and needs of the Quebec population and Aboriginal nations into account in managing the forests. 2. Use forest management practices that ensure ecosystem sustainability. 3. Ensure a productive forest that generates wealth at different levels. 4. Promote diversified, competitive and innovative wood products and forestry industries. 5. Ensure that forests and the forest sector help fight and adapt to climate change.
Allocation of wood	– Allowable Annual Cut (AAC) is established by the Chief Forester. – *Timber supply and forest management agreement* (TSFMA): 1. Signed by the government and a wood processing mill owner. 2. Gives access to harvest a predetermined volume of timber every year (according to the AAC) in a	– AAC for management units and local forests is established by the Chief Forester. – *Timber supply guarantees* replace TSFMAs: 1. Signed by the government and a guarantee holder. 2. Grant its holder the right to purchase a volume of timber each year, but does not require it to carry out forest management work.

	given area, known as a *Forest management unit* (FMU).	3. Introduce the concept of forest development enterprise, that is, a forestry cooperative, joint management organization or private company that is contracted to carry out development activities. 4. Establish that volumes of wood not used by supply guarantee holders during the year can be offered to other mills.
Management of forest resources	– Responsible: mill owner – *General forest management plans* (GFMP) for each FMU: 1. Specify wood allocated and management strategies to protect the forests and their components. It contains a five-year management program. 2. Should be available to the public for 45 days and submitted to the regional county municipality (RCM) and to the Minister. 3. Once the GFMP is approved by the Minister, an annual management plan (AFMP) and an annual management permit are emitted.	– Responsible: Minister of Natural Resources (*Ministère de Ressources naturelles*, MRN) – Integrated forest development plans for each development unit replace GFMPs: 1. The MRN relies on contributions from (a) the regional conferences of elected officers (CRE), that carry out some forest development activities and support the planning process, and (b) local communities (municipalities, RCM and Aboriginal communities), that are in charge of some aspects of land and resource management in local forests. 2. Are contained in *Planning Manuals* that specify tactical and operational plans. The tactical plan presents the goals for sustainable forest development and the forest development strategy to ensure achievement of these goals. The operational plan sets out the forest operations in which logging and other development activities may take place. 3. Forest management permits are emitted.
Sustainability	– Under the *Forest Act*, the Chief Forester must produce a review of sustainable forest development. Moreover, the Act includes a commitment to promote sustainable forest development in order to meet the economic, environmental and social needs of present and future generations while giving proper consideration to other potential uses of the territory. – Modifications to *Forest Act* (2001) include among others: 1. Northern limit for forest harvesting 2. To recognise *Exceptional Forest Ecosystems* – *RSFM*: requires protective strips of forest to be left standing along watercourses, establishes the maximum size of logging areas and specifies maximum areas of soil disturbance (See Tables 14 and 15 for details). – *GFMP 2007-2012* (MRNFP 2005), contains nearly 400 standards required to regenerate the harvested stands and ensure that wildlife and habitats, watercourses and shores, landscapes and soils, and other forest uses are preserved during logging and management activities. Eleven forest *Protection and Development Objectives (PDO)* were retained for the *GFMP 2007-*	– The *SFMA* responds more comprehensively to the demands of environmental management and sustainable forest development. The Regional Operations Sector is introducing a system that will meet the requirements of international standard ISO 14001. – *RSFM* and *GFMP 2008-2013* are currently in use (see Tables 14 and 15 for details). – The *Sustainable forest management regulation* imposes a standard code of conduct in public forests to achieve sustainable and responsible development. New measures include: 1. Forest management is adapted to regional contexts, Aboriginal communities and forest users. 2. Contains a series of additional provisions to promote ecosystem-based management by setting standards for the spatial distribution of logging sites and residual forest blocks in the black spruce feathermoss domain. 3. Ensures that current forest certification is maintained. 4. Wildlife habitats will receive particular attention, especially aquatic, wetland and riparian environments. – As part of the integrated forest development plan, the tactical plan of the *Planning Manual 2013-2018* presents the objectives

	2012. Those associated with the environment relate to: 1. The conservation of soil and water resources (reducing rutting, minimizing losses of productive forest areas and protecting aquatic habitats). 2. The preservation of biological diversity (maintaining mature and overmature forests, spatial distribution of logging areas, protecting the habitats of threatened and vulnerable forest species, structuring pre-commercial thinning operations and preserving dead wood).	and strategy for sustainable forest development.

Table 14. Conformity of British Columbia, Ontario and Quebec legislation with sustainable forest management indicators proposed in the report *Sustainability criteria and indicators for solid bioenergy from forests* (Fritsche et al. 2012)

Indicators (see Table 2 for details)	**British Columbia (BC)**	**Ontario**	**Quebec**
Existence of a forest management plan	Yes (see Table 11)	Yes (see Table 12)	Yes (see Table 13)
Woody bioenergy feedstocks are supplied in accordance with *EU Timber Regulation*	Yes, according to the *Forest and range practices Act* (*FRPA*; Statutes of British Columbia 2002) and *Forest planning and practices regulation* (*FPPR*; Statutes of British Columbia 2004a).	Yes, according to the *Crown Forest Sustainability Act* (*CFSA*; Statutes of Ontario 1994).	Yes, according to *Sustainable forest development Act* (*SFDA*; Statutes of Quebec 2010) and the *Regulation respecting standards of forest management for forests in the domain of the State* (*RSFM*; Statutes of Quebec 1996).
Residue removal is allowed if there is no risk of nutrient depletion (assessed by nutrient risk maps).	– Consideration for site sensitivity to physical damage. The productivity and hydrological function of soils must be conserved (Statutes of British Columbia 2002; 2004a). – Consideration for nutrient depletion and level of residue removal at site series level (Delong 2003).	Residue removal is allowed within the parameters of the conventional *Forest management plan* (OMNR 2010).	The action plan *Developing the value of forest biomass* (referred to as *Biomass action plan*; MRNF 2009a) requires that biomass harvest protect fragile soils. For harvest activities, in general: – There are considerations for site sensitivity to physical damage (e.g., sensitivity disturbance classification system to reduce rutting; Schreiber et al. 2006), but nutrient depletion risk is not addressed. – The *SFDA* (Statutes of Quebec 2010) addresses the conservation of soil and water. According to the *RSFM* (Statutes of Quebec 1996), any cutting without soil protection is prohibited.
Fertilization is allowed in order to prevent nutrient depletion.	Yes, fertilization allowed, application prescribed depending on site conditions and desired outcome, but wood ash recycling is not addressed (Statutes of British Columbia 2002; 2004a).	Fertilization is not addressed. A fertilization project should seek *Environmental Assessment Act* (Statutes of Ontario 1990c) coverage.	According to the *Regulation respecting the application of the Environment quality Act* (Statutes of Quebec 2003), spreading of manure, mineral fertilizers, logging debris from cutting areas and liming material that meets the standards of the "Bureau de normalization du Québec" used for forest management activities in the domain of the State or in private forests are exempt from the authorization from the Minister that is normally necessary when any other types of substances that can cause a

			change in the quality of the environment are added (Statutes of Quebec 2003).
Stumps and roots are left in the forest.	The *BC Bioenergy Strategy* includes forest residues from logging practices, road clearing and other sustainable forestry activities. Stump harvesting is not addressed by BC policy or guidelines.	According to the *Forest biofibre policy direction* (OMNR 2008), biomass refers to "forest resources from Crown lands that are not being utilized for other forest products (e.g., sawlog) and that are made available under an approved forest management plan". Stumps and roots are unavailable for utilization as a forest product (OMNR 2010).	According to the *Biomass action plan* (Table 13; MRNF 2009a), forest biomass is defined as "waste products that result from logging and forest management, and of inferior quality timber that is not suited for industrial use". Stumps and roots are excluded from this definition of forest biomass (MRNF 2009a).
No harvesting in area having steep slope (>35 degree).	Site sensitivity assessment dictates best management practices for sites prone to erosion. The site sensitivity assessment has three components: slope, terrain, and compaction. Sensitivity ratings are low - L, moderate - M, and high - H, with a site's sensitivity based on its most limiting feature. Slope: <30%: L; >30%: H. The general suitability of ground-based harvesting systems according to site sensitivity is: -High sensitivity: avoid ground-based systems. -Medium sensitivity: lower-impact ground-based systems acceptable (e.g., hoe-forwarding, low ground pressure skidders); designated skid trails preferred to facilitate rehabilitation. -Low sensitivity sites: ground-based systems acceptable. Site sensitivity reflects potential harvesting impacts; actual impact depends on site conditions during logging, and on the nature and quality of the logging practices (Lewis & Timber Harvesting Subcommittee 1991). Even low sensitivity sites can be significantly affected if harvested improperly (e.g., multiple passes, wet weather, blading away protective organic material and surface mineral horizons) (Green &	*Best management practices* for high erosion risk areas exist, but no mandatory standard in place (OMNR 2010). Extremely steep slope areas as considered inoperable and machine travel should be avoided. The specific steepness threshold should be determined locally, based on site conditions and available machinery (OMNR 2010).	– Harvesting in areas having >40% slope requires a preventive silvicultural prescription (Jetté et al. 1998). – Moreover, slope is considered within the classification system of sensitivity to rutting, together with drainage, texture and surficial deposit thickness and type (Schreiber et al. 2006). Slope classes considered are: A = 0 à 3 % (no slope); B = 4 à 8 % (light); C = 9 à 15 % (weak); D = 16 à 30 % (moderated); E = 31 à 40 % (forte); F = > 40 % (steep).

	Klinka 1994).		
Residue removal is allowed from soils with low to medium disturbance risk according to the soil disturbance maps developed at stand level.	Not specified for residue removal. For harvesting activities in general on sensitive soils, a maximum of 5% of the area to be reforested may be affected by soil disturbance, while this percentage is 10% where soils are not predominantly sensitive. Sensitive soils are defined as those that, because of their slope gradient, texture class, moisture regime or organic matter content have a very high hazard for the Interior, or a high or very high hazard for the Coast, of displacement, surface erosion or compaction (*FPPR*; Statutes of British Columbia 2004a).	Not specified. Stand and site guide – Guideline (mandatory, interpreted by applying local knowledge and site conditions): organic matter that is not part of a harvested tree (including boles, branches, roots, bark, leaves, needles, debris, soil carbon, etc.) will remain on site. Movement of such material for access or silvicultural purposes is permitted (OMNR 2010).	– The *Biomass action plan* (MRNF 2009a) specifies that biomass harvesting should protect fragile soils. – The area occupied by skid trails bust be less of 25% (or less than 33% under certain conditions) of the block area (Statutes of Quebec 1996). – The *General forest management plans 2008-2013* developed a sensitivity disturbance classification system to reduce rutting (Schreiber et al. 2006). – According to the guide *"Le reboisement au Québec: guide terrain pour le choix des essences résineuses"* (Cauboue 1988), harvesting is not permitted on soils with drainage class 5 (poor) or 6 (very poor) (Cauboue 1988) unless soils are frozen to a depth of at least 35 cm (Statutes of Quebec 1996). – As part of the *Forest protection strategy* (MRNQ 1994), three types of physical soil disturbances have been monitored: rutting, loss of productive land and erosion.

Protecting biodiversity

Federal

As explained in previous sections, the term "primary forest" is not used in regulations in Canada and therefore is not specifically protected. However, high conservation value forests are preserved in designated protected areas (see section 1.2.1.2) both at the federal and provincial level. Biodiversity is also addressed through protection of specific ecological features within managed areas according to standards and guidelines intended to maintain forest health and long-term forest sustainability (hereafter described). For example, in provincial regulations, there are some provisions for the protection of old-growth forests, and for retention of wildlife patches in logging areas.

British Columbia

According to the *Forest and range practices Act* (Statutes of British Columbia 2002; FPB 2012), licenses required to prepare and submit a *Forest stewardship plan* for government approval must include strategies that are consistent with objectives, including those for old-growth, that are set by the government (Table 15). Old-growth management areas in BC are designated within the province's managed forest in order to retain old-growth values in the long-term (MELP 1999). Biomass can be harvested from forests with high risk of hazards and from salvage logging (Statutes of British Columbia 2002; 2004a). Some reports (e.g., Klenner 2006) outline practices to help protect and maintain habitat structure and wildlife diversity during salvage harvesting. The *Forest planning and practices regulation* sets out requirements for riparian areas (Statutes of British Columbia 2004a). Buffer widths vary from 20 to 100 m, depending on the class of the stream (Table 13). Requirements of retention of coarse woody debris (CWD) under the *Forest and range practices Act* are minimal (4 logs/ha; Statutes of British Columbia 2002). Moreover, according to the *Waste assessment policy* (MFLNRO 2008) and the *Provincial logging residue and waste measurement procedures manual* (MFLNRO 2010), timber that is not removed during harvesting may be subjected to penalty. There are other non-legal documents that contain detailed guidelines for CWD management. For example, the *Chief Forester's guidance on CWD management* (MFML 2010) help raise awareness about the importance of CWD planning and management. The reports *Strategies for maintaining or recruiting habitat in areas affected by mountain pine beetle and other catastrophic events* (Manning et al. 2006) and *Silviculture guidelines and practices for maintaining or recruiting key habitat objectives* (MCA 2004) specifically consider the value of CWD as wildlife habitat. Monitoring on CWD after harvesting is done at the stand level for soil and biodiversity (e.g., Curran et al. 2009). Management practices are intended to avoid colonization by pioneer species and maintain low levels of competing vegetation (MCA 2004). Finally, according to *Forest planning and practices regulation* (Statutes of British Columbia 2004a), harvesting cannot be performed in 3.5% of a harvesting block area. These tree retention areas are preserved for wildlife conservation.

Ontario

The *Old growth policy for Ontario's Crown forests* (OMNR 2003) provides provincial directions for the identification and conservation of old-growth conditions and values for forest community associations present in Ontario's Crown forests (Table 15).According to the *Forest biofibre policy* (OMNR 2008), forest biofibre can be comprised of trees that may be salvaged as a result of a natural disturbance. Harvest systems in general must maintain the ecological integrity of the site, and ensure protection of water, soil and aquatic resources (Statutes of Ontario 1994; OMNR 2010). To protect freshwater resources, riparian buffers must be established (OMNR 2010). Buffer widths depend on site conditions and *Area of*

concern established to manage specific wildlife values. In Ontario there are standards of wildlife tree retention (OMNR 2010). Management practices are intended to avoid colonization by pioneer species where they are not desired (OMNR 2010).The number of living, dead, cavity and supercanopy trees that must be left behind as individuals, in patches or lying on the ground depends on the silviculture system used.

Quebec

Forest development activities are prohibited in old-growth forests of Quebec, except under circumstances authorized by the Natural Resources Minister (Statutes of Quebec 2010; Table 15). These forests may be protected as *Old-growth forests*, a category of *Exceptional forest ecosystems*, under the *Sustainable forest development Act* (Statutes of Quebec 2010) if they do not show anthropogenic effects and they have experienced no major natural disturbances in recent times (MRN 2001). Salvage logging requires a special development plan to ensure that the timber is salvaged using the appropriate silvicultural treatments (Statutes of Quebec 2010). Buffer strips 20-m wide must be protected along peat bogs, swamps, marches, lakes and watercourses (Statutes of Quebec 1996). However, harvesting in these buffers is allowed if the land has a slope of less than 40%. Forest development activities are not permitted in the riparian zones of a salmon river (Statutes of Quebec 2010). According to directives associated with the *General forest management plan 2008-2013* (MRNF 2012), 20% of the total productive areas located in riparian zones should be protected to allow for the development of very old trees, which will eventually become large snags and debris (Déry & Labbé 2006).

The *Sustainable development Act* (Statutes of Quebec 2006), the *Sustainable forest development Act* (Statutes of Quebec 2010) and the *Biomass action plan* (MRNF 2009a) address biodiversity preservation. The *Biomass action plan* states that at least 30% of woody material must be left on the site during harvesting (MRNF 2009a). Moreover, the impact of harvesting woody biomass on forest ecosystems must be monitored. In the context of forest harvesting in general, the *General forest management plan 2008-2013* (MRNF 2007; 2010a) states five types of measures to ensure biodiversity conservation: (1) preserving biological refuges and patches of mature and overmature forests (Déry & Leblanc 2005a; b; Leblanc & Déry 2005a; b), (2) implementing spatially distributed harvests adapted to regional ecology and socially acceptable (MRNFP 2005; Pouliot et al. 2010), (3) protecting habitats of threatened or vulnerable species and *Exceptional forest ecosystems* (MRNF 2007), (4) regulating pre-commercial thinning (Cimon & Labbé 2006; MRNF 2007), and (5) conserving dead wood (Leblanc 2004; MRNF 2010a).

As part of the forest development activities regulated under the *Sustainable forest development Act* (Statutes of Quebec 2010), suppression of competing vegetation is envisaged to prevent modification of forest composition. The MRN developed several guidelines to avoid proliferation of some well-known competing species (e.g., ericaceous shrubs in black spruce-feathermoss forests of Quebec; Grondin & Cimon 2003). There is also a *Northern limit for timber allocations* (MRN 2000) which prohibit forest harvesting in areas located above this limit (MRN 2012b).

Table 15. Conformity of British Columbia, Ontario and Quebec legislation with biodiversity indicators proposed in the report *Sustainability criteria and indicators for solid bioenergy from forests* (Fritsche et al. 2012)

Indicators (see Table 2 for details)	BC	ON	QC
Biomass should not be harvested in *High conservation value forests*	Yes, in nationally and provincially designated protected areas and habitat or ecological features subject to special regulations. Partly, in managed forest area, where high conservation value habitat and ecological features are retained according to standards and guidelines intended to maintain forest health over the long term.		
Primary forest (old-growth forest or tropical primary forest) should be excluded unless evidence is provided that biomass harvest does not interfere with nature protection purposes	The term "primary forest" is not applied in Canada.		
	Yes, according to the *Forest and range practices Act* (*FRPA*; Statutes of British Columbia 2002). Old-growth management areas are designated within BC's managed forest in order to retain old-growth values in the long-term, set using non-spatial area targets (MELP 1999).	Yes, according to the *Old growth policy for Ontario's Crown forests* (OMNR 2003). This policy provides provincial directions for the identification and conservation of old-growth conditions and values for forest community associations present in Ontario's Crown forests.	Yes, according to the *Sustainable forest development Act* (*SFDA*; Statutes of Quebec 2010). Under this Act, the forests in the domain of the State may be constituted as *Exceptional forest ecosystems* (*EFE*) because of their biological diversity (shelter forests), scarcity (rare forests) or age (old-growth forests). Old-growth forests refer to stands that do not show anthropogenic effects and that have experienced no major natural disturbances in recent times (MRN 2001). All forest development activities are prohibited in *EFE*, except under circumstances authorized by the Minister and that do not have an adverse effect on the conservation of biological diversity (Statutes of Quebec 2010).
Bioenergy from forests residues may be sourced from forests with high risk of hazards or from salvage logging.	Yes, according to *FRPA* (Statutes of British Columbia 2002) and *Forest planning and practices regulation* (*FPPR*; Statutes of British Columbia 2004a) for harvesting. Other non-legal documents outline practices to help protect and maintain habitat structure and wildlife diversity during salvage harvesting (e.g., Klenner 2006).	Yes, e.g. Stand and Site Guide – According to the Forest biofibre policy (OMNR 2008), forest biofibre may be comprised of: 1. unmerchantable timber such as undersized wood, cull trees or portions of trees, 2. individual trees and stands of trees that are merchantable, and 3. trees that may be salvaged as a result of a natural disturbance. Biofibre may be the primary (e.g., otherwise unmarketable stand of low-grade hardwoods) or	Yes, according to the *SFDA* for harvesting (Statutes of Quebec 2010). The Act requires a special development plan to ensure that the timber is salvaged using the appropriate silvicultural treatments.

		secondary (e.g., undersized material after optimizing recovery of veener and sawlog) product of a planned harvest operation (OMNR 2010).	
At least 100 m of riparian ecosystems from the watercourse are established to protect freshwater resources.	– Yes, according to *FPPR* (Statutes of British Columbia 2004a). Buffer widths vary (20-100 m) depending on the class of the stream. Buffers for *Riparian reserve zones* (RRZ) and *Riparian management zones* (RMZ), respectively, vary from 0 to 50 m and 20 to 100 m. Wetlands have different riparian classes depending on the wetland size and biogeoclimatic zone. – Restrictions in these buffers: RRZ, no roads, unless no other location available; and RMZ, residual standing trees must achieve minimum basal area targets (%).	Buffer width dependent on site conditions and *Area of concern* establishment to manage specific wildlife values) (OMNR 2010).	– Buffer strips 20-m wide should be protected along the banks of a peat bog, a swamp, a marsh, a lake or a permanent watercourse (Statutes of Quebec 1996). However, trees can be harvested in watercourse buffers if the land has a slope of less than 40% (Statutes of Quebec 1996). – All forest development activities are prohibited in the riparian zones or part of these riparian zones of a salmon river (Statutes of Quebec 2010). – To satisfy sustainable management requirements, one of the directives associated with the *General forest management plan 2008-2013* aims to protect 20% of the total productive areas located in riparian zones (Déry & Labbé 2006).
An adequate amount of residues is evenly left on the ground to protect biodiversity	– Yes, according to *FPRA* and *FPPR* (Statutes of British Columbia 2002; 2004a). There is a mandatory minimum density of coarse woody debris (CWD) and snags to be left on site after harvest, ((a) if the area is on the Coast, a minimum of 4 logs per hectare, each being a minimum of 5 m in length and 30 cm in diameter at one end; (b) if the area is in the Interior, a minimum of 4 logs per hectare, each being a minimum of 2 m in length and 7.5 cm in diameter at one end; as well as guidelines for maintaining certain types of debris. – Also there are non-legal documents that have the objective of providing guidance and raise awareness about the importance of CWD:	Yes. Depending on silviculture system used (clearcut, selection, shelterwood, seed tree) there are standards of wildlife tree retention (number of living, dead, cavity, supercanopy trees of at least a certain diameter per hectare) and pieces of woody debris (>7.5cm diameter) per hectare (OMNR 2010).	– Yes, the *Sustainable development Act* (Statutes of Quebec 2006), the *SFDA* (Statutes of Quebec 2010) and the action plan *Developing the value of forest biomass* (referred to as *Biomass action plan*; MRNF 2009a) address biodiversity preservation in general. – The *Biomass action plan* (MRNF 2009a) states that at least 30% of woody material must be left on the site during harvesting. The impact of harvesting woody biomass on forest ecosystems must be monitored.

	– Chief Forester's guidance on CWD management (MFML 2010), A short-term strategy for CWD management in BC's forests (MFR 2000), Strategies for maintaining or recruiting habitat in areas affected by mountain pine beetle and other catastrophic events (Manning et al. 2006), Silviculture guidelines and practices for maintaining or recruiting key habitat objectives (MCA 2004). – Monitoring on CWD after harvesting is done at the stand level for soil and biodiversity (Curran et al. 2009).		
Residual harvesting should be performed in a way that does not allow the occurrence of pioneering species	Yes. According to non-legal documents, management practices such as site preparation and planting of desired species post-harvest are intended to avoid colonization by pioneer species and maintain low levels of competing vegetation (MCA 2004). Moreover, the *Invasive plants regulation* (Statutes of British Columbia 2004e) provides lists of invasive species for consideration in *Forest stewardship plans* and woodlot license plans under *FRPA*.	Yes. Management practices (e.g., site preparation and planting of desired species post-harvest) are intended to avoid colonization by pioneer species where they are not wanted (OMNR 2010).	Yes. Silvicultural treatments such as the suppression of competing vegetation are considered part of the forest development activities regulated under the *SFDA* (Statutes of Quebec 2010).
In case that retention forestry is performed in previous activities, live cavity trees, den trees, other live decaying trees, and snags left should be respected	Yes, according to *FPRA* and *FPPR* (legal documents outline practices to help protection). At end of any harvest, 3.5% of harvest area must contain wildlife tree retention area, and after 12 months, the area covered by wildlife tree retention areas that relate to the cutblocks is a minimum of 7% of the total area. These wildlife tree retention areas may not be harvested until they reach mature seral condition.	Yes. Depending on silviculture system used (clearcut, selection, shelterwood, seed tree) there are standards of wildlife tree retention (number of living, dead, cavity, supercanopy trees of at least a certain diameter per hectare) (OMNR 2010).	The *General forest management plan 2008-2013* (MRNF 2007) states five types of measures that vary regionally (see MRNF 2007 for these regional details) to ensure conservation of biodiversity: 1) Conservation of mature and overmature forests. The MRN developed guidelines for preserving biological refuges and patches of mature and overmature trees (Déry & Leblanc 2005b; a; Leblanc & Déry 2005b; a). 2) Implement spatially distributed harvests adapted to regional ecology and socially acceptable. In the black spruce-feathermoss forest of Quebec, clusters of trees measuring 100 m^2 each must be left intact (MRNFP 2005; Pouliot et al. 2010) .

			3) Protection of habitats of threatened or vulnerable species and *EFE*. Protection of these sites must be integral (MRNF 2007). 4) Regulated management of pre-commercial thinning. Percentage of the forest submitted to pre-commercial thinning should be less than 90% (Cimon & Labbé 2006; MRNF 2007). 5) Dead wood conservation: – Protect 20% of the total productive areas located in riparian zones (Déry & Labbé 2006). – Snags and non-commercial living trees must be left standing provided they do not compromise management objectives or worker's safety (MRNF 2010a). – In selection cutting areas, large dying trees (vigour class IV (M)) with a basal area of at least 1 m^2/ha must be left untouched (MRNF 2010a). – 5% of CPRS harvests should be performed using the clump retention technique (Leblanc 2004).

3.2. United States (US)

Parts of the following sections have been published in the article: Endres, Jody M., Barking Up the Wrong Tree? Forest Sustainability in the Wake of Emerging Bioenergy Policies (January 2, 2013). 37 Vermont Law Review 1 (2013). Available at SSRN: http://ssrn.com/abstract=2197386

3.2.1. Introduction

Twenty years have passed since the Fish and Wildlife Service's controversial listing of the Northern Spotted Owl as an endangered species, triggering highly-publicized debate surrounding government-sanctioned, clear-cutting of forest habitats throughout the Northwestern US[2]. The spotted owl controversy revealed that federal forest management policies alone could not guarantee functioning forest ecosystems. At the same time as the owl's listing, agreements made at the 1992 Rio Earth Summit highlighted the mounting pressures on natural systems, thus unofficially marking the advent of sustainable forestry management (SFM)[3]. While threats to forest ecosystems from traditional logging practices certainly remain[4], developed and developing countries have generally shifted toward more sustainable forest management, at least on paper, including codification in public laws of various sustainability indicators[5].

Scientific consensus has grown in recent years around a new and arguably more onerous threat to all of the world's ecosystems—climate change. Governments' responses have focused on bioenergy policies aimed at curtailing anthropogenic GHG emissions, and mandates for renewables in energy supplies now abound worldwide. In the US alone, the federal Renewable Fuel Standard (RFS) requires biofuels blending in transportation fuels[6], and Clean Air Act (CAA) permitting of GHG emissions considers, at least for the moment, biogenic sources as carbon neutral[7]. Various state-level renewable portfolio standards[8] and California's Low Carbon Fuel Standard also incentivize biomass-based fuels[9]. The EU Renewable Energy Directive (RED)[10] and Fuel Quality Directive[11] seek similar ramp-ups in bioenergy portfolios and

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[2] William Yardley, Plan Issued to Save Northern Spotted Owl, N.Y. TIMES, June 30, 2011, http://www.nytimes.com/2011/07/01/us/01owls.html?pagewanted=all&_r=O.

[3] Andrew Long, Auditing for Sustainable Forest Management: The Role of Science, 31 COLUM. J. ENVTL. L. 1, 6–7 (2006); United Nations Conference on Environment and Development, Rio de Janiero, Braz., June 3–14, 1992, Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests, Preamble (d) 2, U.N. Doc. A/CONF.151/26 (Vol. III), Annex III (Aug. 14, 1992), available at http://www.un.org/documents/ga/conf151/aconf15126-3annex3.htm (declaring that its principles were the "first global consensus on forests," and recognizing the role of forests in producing bioenergy and as a carbon sink).

[4] Preface, Evaluating sustainable forest management, 8 ECOLOGICAL INDICATORS 109, 110 (2008).

[5] G.T. McDonald & M.B. Lane, Converging Global Indicators for Sustainable Forest Management, 6 FOREST POL. & ECON. 63, 64 (2004); Don Wijewardana, Criteria and Indicators for Sustainable Forest Management: The Road Travelled and the Way Ahead, 8 ECOLOGICAL INDICATORS 115, 115 (2008).

[6] CARLOS RODRIGUEZ-FRANCO, US FOREST SERV., BIOMASS FOR ENERGY & CONSERVATION: CAN WE DO BOTH? 15 (2010), available at http://ageconsearch.umn.edu/bitstream/60355/1/FrancoC.pdf; BIOMASS RESEARCH & DEV. INITIATIVE, VISION FOR BIOENERGY AND BIOBASED PRODUCTS IN THE UNITED STATES: BIOECONOMY FOR A SUSTAINABLE FUTURE 7 (2006), available at http://www1.eere.energy.gov/biomass/pdfs/final_2006_vision.pdf.

[7] Deferral for CO2 Emissions from Bioenergy and Other Biogenic Sources Under the Prevention of Significant Deterioration (PSD) and Title V Programs, 76 Fed. Reg. 43,489, 43,490–91, 43,495 (July 20, 2011) (codified at 40 C.F.R. pts. 51, 52, 70, 71).

[8] US DEPT. OF ENERGY ET AL., DATABASE OF STATE INCENTIVES FOR RENEWABLES AND EFFICIENCY, RENEWABLE PORTFOLIO STANDARDS POLICIES (2013), available at http://www.dsireusa.org/documents/summarymaps/RPS_map.pdf. (noting over twenty-five states have renewable portfolio standards).

[9] CAL. CODE REGS. tit. 17, § 95480 (2013).

[10] Council Directive 2009/28/EC, of the European Parliament and of the Council of 23 April

corresponding carbon reductions[12]. As a signal of its commitment, the EU Commission recently announced it would contribute €170 million toward a wood-based biodiesel refinery sourced from logging residues and bark[13].

Forests thus could play an important role in achieving these mandates as they hold potential as feedstocks and carbon sinks. The US Department of Agriculture (USDA) recently estimated that residues from almost 11 million acres of forests in the US could be used to produce 2.8 billion gallons of advanced biofuel by 2022[14]. The Department of Energy estimates potential yield from forest and agricultural resources at anywhere from 187 to 602 dry tons by 2022, with each dry ton yielding as much as eighty-five gallons per ton[15].14 Estimates in California alone of total forest biomass available for energy production range from 402 million to 190 million dry tons[16].

Worldwide, the 3.9 billion hectares of forested lands have the sequestration potential of 5 to 11 tons of CO_2 per hectare per year[17]. Deforestation, however, particularly in Southeast Asia and South America, accounts for seventeen percent of the world's yearly total emissions of CO_2[18]. The onslaught of new forest biomass demand created by renewable energy policies could result in further direct and indirect conversion, releasing copious amounts of carbon into the atmosphere. This scenario calls into question the accuracy of various renewable energy policies' accounting for GHG emissions from conversion, in addition to measuring emissions from forestry practices and combustion of forest biomass[19]. The Center for Biological Diversity

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2009 on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC, 2009 O.J. (L 140) 16 (EC)[hereinafter RED].

[11] Council Directive 2009/30, 2009 O.J. (L 140) 88, 89 (EC).

[12] See, Renewable Energy: Targets by 2020, EUR. COMM'N, http://ec.europa.eu/energy/renewables/targets_en.htm (last visited Jan.31, 2013) (noting the Commission's renewable energy targets).

[13] EU Awards NER300 Technology Grant For UPM's Biorefinery Project in France, UPMKYMMENE CORP. (Dec. 18, 2012), http://www.upm.com/EN/INVESTORS/Investor-News/Pages/EUawards-NER300-technology-grant-for-UPM%E2%80%99s-biorefinery-project-in-France-001-Tue-18Dec-2012-16-05.aspx; E.U. COMMISSION, COMMISSION IMPLEMENTING DECISION, Award Decision under the First Call for Proposals of the NER300 Funding Programme 7 (Dec 18, 2012), available at http://ec.europa.eu/clima/news/docs/c_2012_9432_en.pdf.

[14] US DEP'T OF AGRIC., A USDA REGIONAL ROADMAP TO MEETING THE BIOFUELS GOALS OF THE RENEWABLE FUELS STANDARD BY 2020 5–6 (June 23, 2010), available at http://www.usda.gov/documents/USDA_Biofuels_Report_6232010.pdf (stating that the 2.8 billion gallons would come from 42.5 million dry tons of logging residues).

[15] US DEP'T OF ENERGY, US BILLION–TON UPDATE: BIOMASS SUPPLY FOR A BIOENERGY AND BIOPRODUCTS INDUSTRY 146 (2011), available at http://www1.eere.energy.gov/biomass/pdfs/billion_ton_update.pdf.

[16] NATURAL RES. DEF. COUNCIL, BIOFUELS FACTS: BUILDING A SUSTAINABLE BIOMASS INDUSTRY IN CALIFORNIA WITHOUT SACRIFICING OUR UNIQUE NATURAL HERITAGE (April 2009), available at http://www.nrdc.org/energy/files/CAbiomassFS_0409_04.pdf (citing a 2005 California Energy Commission Report titled Biomass Resource Assessment in California, found at http://www.energy.ca.gov/2005publications/CEC-500-2005-066/CEC-500-2005-066-D.PDF). Another report from 2005 puts per year forest materials availability within California at 14–26 million dry tons.
CAL. BIOMASS COLLABORATIVE, BIOMASS IN CALIFORNIA: CHALLENGES, OPPORTUNITIES, AND POTENTIALS FOR SUSTAINABLE MANAGEMENT AND DEVELOPMENT 15 (2005) [hereinafter BIOMASS CHALLENGES], available at http://biomass.ucdavis.edu/files/reports/2005-cbc-biomass-in-ca-whitepaper.
pdf.

[17] BRENT SOHNGEN, COPENHAGEN CONSENSUS CENTER, AN ANALYSIS OF FORESTRY CARBON SEQUESTRATION AS A RESPONSE TO CLIMATE CHANGE 5, 7 (2009), available at http://fixtheclimate.com/uploads/tx_templavoila/AP_Forestry_Sohngen_v.2.0.pdf. See also Gert Jan Nabuurs et al., Forestry, in CLIMATE CHANGE 2007: MITIGATION, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, 557–558 (B. Metz et al. eds., 2007) (estimating global annual sequestration potential of forests in 2030
at 13,775 MtCO2 under certain carbon price scenarios).

[18] 17. SOHNGEN, supra note 16, at 5.

[19] See, e.g., Timothy Searchinger et al., Use of US Croplands for Biofuels Increases

and other environmental group petitioners have pursued at least two claims against the US Environmental Protection Agency (EPA) challenging its conclusion that forest biomass is carbon neutral or at the very least worthy of further study before arriving at a final accounting[20]. Forest conversion also can cause ecosystem degradation such as loss of biodiversity and a decline in water quality[21]. Fearing this outcome, environmental groups recently unsuccessfully challenged one federally-funded, forest-to-bioenergy project on the grounds that existing government and private sustainability certification regimes cannot guarantee that negative ecological impacts from forest harvests will be mitigated[22].

The policy foundation on which SFM has been built over the past thirty years provides important insight into how it may evolve in coming decades in response to the newly emerging forest bioenergy feedstock paradigm. As acknowledged in the US Department of Agriculture's (USDA) 2010 National Forest Sustainability Report, the term "sustainability" can have many different meanings[23]. The agency increasingly uses the "triple bottom line"—economic, social, and environmental—to describe its commitment to sustainability[24]. Commentators have categorized the triple bottom line approach as "weak" or "strong,"[25] depending on the degree to which a policy recognizes that economic activity does not operate within a vacuum. That is, when applying the approach, the needs of society as a whole— including minimum environmental values that "cannot be obtained through any other means" by future generations—should be included in sustainability calculations[26].

The extent to which forests are sustainably managed for bioenergy production and carbon sequestration depends on several factors, including the type of forest that generates biomass. Forests are typically classified as primary or secondary. Primary forests are forests of native species without "clearly visible indications of human activities and the ecological processes have not been significantly disturbed," whereas secondary forests are defined as forests formed as a consequence of human impact on forest lands, excluding plantations[27]. In addition

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Greenhouse Gases Through Emissions from Land-Use Change, 319 SCI. 1238, 1238 (2008); Joseph Fargione et al., Land Clearing and the Biofuel Carbon Debt, 319 SCI. 1235 (2008) (noting that switching to biofuels can have greater GHG impacts than fossil fuels because the switch involves indirect land use changes). See also U.N. Econ. Comm'n for Eur./Food & Agric. Org. of the U.N., Forest Products Annual Market Review 2008-2009 111 U.N. Doc. ECE/TIM/SP/24 (2009), available at http://www.unece.org/fileadmin/DAM/timber/publications/Final_FPAMR2009.pdf ("A need exists to coordinate and harmonize the various forestry certification frameworks for sustainable timber production, sustainable biomass production and carbon sequestration").

[20] Request for Correction from the Ctr. for Biological Diversity to the EPA Regarding Emissions from Biomass Combustion in the Inventory of US Greenhouse Gas Emissions and Sinks 1 (July 28, 2010), available at http://www.epa.gov/quality/informationguidelines/documents/10006.pdf; see infra note 83 and accompanying text (explaining Clean Air Act stationary source litigation).

[21] See, e.g., Comments from Cal. Energy Comm'n on the Interagency Forestry Working Group 2 (Mar. 18, 2009), available at http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/mission_and_goals/charter/californiaenergycommission.pdf (raising concerns about the sustainability of existing regulations regarding forest biomass collection activities).

[22] Klein v. US Dep't of Energy, No. 2:11-cv-514, 32–34 (W.D. Mich. Dec. 11, 2012) (order denying plaintiff's motion for summary judgment).

[23] US DEP'T OF AGRIC., NATIONAL REPORT ON SUSTAINABLE FORESTS—2010 I-2 (2011), available at http://www.fs.fed.us/research/sustain/docs/national-reports/2010/2010-sustainabilityreport.pdf [hereinafter USDA REPORT].

[24] Id. (citing Exec. Order No. 13,423, 3 C.F.R. 381 (2007) ("'Sustainable' means to create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirement of present and future generations of Americans.")).

[25] ALLEN HAMMOND ET AL., WORLD RES. INST., ENVIRONMENTAL INDICATORS: A SYSTEMATIC APPROACH TO MEASURING AND REPORTING ON ENVIRONMENTAL POLICY PERFORMANCE IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT 23 (1995), available at http://pdf.wri.org/environmentalindicators_bw.pdf.

[26] USDA REPORT, supra note 22, at I-2.

[27] Food and Agric. Org. of the U.N., Global Forest Resources Assessment 2010 xviii (2010)

to these forests, monocultured trees grown plantation-style specifically for biomass—"short rotation woody crop (SRWC) biomass — will likely become more widespread with increasing genetic discovery.[28] In the future, forests could contain both trees and intercropped grasses such as switch grass, which could require an additional set of management practices. Ownership also dictates what sustainability regulations apply to a forest in question. For example, in the US, government-owned forest land can be subject to either federal or state jurisdiction. If forest land is held privately, the state jurisdiction in which the stand sits applies. Nations also may be parties to international treaties that dictate some form of SFM.

The future market for forest energy biomass can determine what SFM practices owners follow. While companies and consumers can create voluntary market pull for more sustainable practices, compliance with government mandates and other laws often requires some form of SFM that is embedded in the very definition of what qualifies as woody biomass. Many question why existing forest management laws cannot be used to meet bioenergy sustainability prescriptions[29]. Others counter that for years private certification organizations have been developed to fill holes in SFM that national governments either could or would not patch,[30] and that bioenergy policy therefore must exercise precaution.[31]

In an effort to determine which of these positions is more accurate— precaution versus more aggressive sourcing—policymakers must consider and incorporate SFM within newly emerging bioenergy mandates and in light of novel scientific questions. The following sections clarify this by laying out how bioenergy and general SFM public policies in the US recognize, to varying degrees, the need for forest protections unique to biomass-based energy.

3.2.2. The US legislation and the EU RED
Defining and regulating lands with high biodiversity

In the following sections, we use the case study of primary forests to show how operational definitions and regulations related to lands with high biodiversity value, which are considered 'no-go areas' in the *RED* sustainability criteria listed in Table 1, are addressed in the US, both at the federal and state level.

Federal lands

A look at forest protection in the United States highlights how the operational definitions have evolved for federal lands. Laws such as the federal Organic Act, Wilderness Act, the Multiple Use and Sustained Yield Act, the National Forestry Management Act, Wild and Scenic Rivers Act, and the National Environmental Policy Act, shape administrative authority to enact, enforce, and follow through with operational definitions for forest preservation. The US has

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[hereinafter FAO 2010 Assessment]; Richard T. Corlett, What is Secondary Forest?, J. OF TROPICAL ECOL., 1999 at 445, 445 (noting that it is possible that this definition does not adequately capture the true nature of secondary forest in the case of tropical secondary forest, as virtually all tropical forests have "suffered some form of human impact").

[28] G.A. Tuskan, Short-Rotation Woody Crop Supply Systems In The United States: What Do We Know, And What Do We Need To Know? 14 BIOMASS & BIOENERGY 307, 311 (1998) (explaining the characteristics of short rotation woody crop supply systems).

[29] I currently chair the US Council for Sustainable Biomass Production, www.csbp.org; sit in a Chamber of the Roundtable for Sustainable Biofuels, and participate in the California Low Carbon Fuel Standard Sustainability Workgroup.

[30] See Errol Meidinger, Competitive Supragovernmental Regulation: How Could It Be Democratic?, 8 CHI. J. INTL. L. 513, 513 (2008) (discussing the benefits of competitive supragovernmental regulation as implemented by nonstate actors).

[31] Trevor P. Hesselink, Increasing Pressure to Use Forest Biomass: A Conservation Viewpoint, THE FORESTRY CHRONICLE, Jan.–Feb. 2010, at 28, 29.

been concerned with preserving and protecting federal forests since the late 1800s.[32] Initially, however, conservation of biodiversity was not the focus, and instead forests were managed according to "multiple use" weighed primarily in favor of harvests.[33] After several years, forest values beyond extraction interests, such as recreation and ecosystem support, became more evident and in 1960 Congress passed the Multiple Use and Sustained Yield Act (MUSYA) to enhance enacted laws.[34] MUSYA expanded the purposes of forest preservation to include outdoor recreation, range, timber, watersheds, and wildlife and fish purposes.[35] Four years later, Congress reviewed the Forest Service's designations of wilderness areas since the Service's inception, and, in response, decided that it wanted to place the ultimate determination of wilderness area classification with Congress.[36] Consequently, Congress passed the Wilderness Act.[37] This act created a procedure for the Forest Service to determine what should be considered as wilderness area, and then recommend that Congress designate such areas accordingly.[38] The Wilderness Act defines "wilderness" as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain[;] ... an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions[.]"[39] With its attendant attributes outlined in statute, the Wilderness Act more explicitly identified the ecological importance of forests.[40]

Concerned with the manner in which the Forest Service was allowing clear-cutting and the prevailing role that timber production played in its policies, Congress amended the Wilderness Act, and enacted for the first time the National Forestry Management Act (NFMA) in 1976.[41] Congress feared that without intervention or additional, outside input, the Forest Service would use the national forests as monoculture tree farms.[42] Consequently, NFMA requires that the Forest Service coordinate with state and local governments, as well as other Federal agencies when developing Land and Resource Management Plans (LRMP) newly added by the Act.[43] NFMA commands that the Forest Service develop separate plans for each forest within the National Forest System.[44] Congress specifically provided that the Forest Service should not have a "one-size-fits-all" approach to forestry management,[45] due to the varying biological and socio-economic conditions across the national forests. National attention thus began to focus on the importance conservation of biodiversity.

Over the past few decades, a planning rule developed in 1982 has regulated the manner in which the Forest Service implements its LRMPs.[46] However, understanding about how to implement effective management plans has changed. While the Forest Service has been attempting to amend the planning rule since the 1990s, only in 2012 did the Forest Service succeed in issuing a final nationwide planning rule that provided a new framework for unit

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[32] 16 USC. §§ 473–482, 551 (the Organic Act of 18XX).
[33] *Id.* at § 475.
[34] *Id.* at § 528–531.
[35] *Id.* at § 528.
[36] *See Parker v. United States*, 309 F. Supp. 593, 597 (D. Colo. 1970), aff 'd, 448 F.2d 793 (10th Cir. 1971) (quoting H.R. Rep. No. 88-1538, 1964 USC.C.A.N. at 3616).
[37] 16 USC. §§ 1131–1136.
[38] *Id.* at § 1132(b).
[39] *Id.* at § 1131(c).
[40] *Id.*
[41] *See* Sierra Club v. Thomas, 105 F.3d 248, 249-50 (6th Cir.1997), reversed on ripeness grounds in Ohio Forestry Ass'n v. Sierra Club, 523 US 726 (1998).
[42] *Id.*
[43] 16 USC. § 1604(a).
[44] *Id.* at § 604(f)(1).
[45] S. Rep. No. 94-893, at 26; 35, reprinted in 1976 USC.C.A.N. 6662, 6694.
[46] 77 Fed. Reg. 21162 (Apr. 9, 2012).

level management plans.[47] At a baseline, the 2012 planning rule emphasizes adaptability, collaboration, transparency, public involvement, and scientific input.[48] The rule specifically incorporates a "science-based" requirement to provide for plant and animal diversity and the continued presence of native species by providing for ecosystem integrity and diversity.[49] It further provides for species diversity by implementing additional provisions for at-risk species.[50] Management plan components must be designed to provide habitat to preserve common species as common, assist in the recovery of threatened and endangered species, conserve candidate and proposed species, and maintain species of concern.[51]

NFMA and the Wilderness Act are not the only avenues that the Forest Service may use to preserve forests and habitat. Under its general authority and pursuant to the Wild and Scenic Rivers Act,[52] the Forest Service has attempted to both inventory and protect roadless areas within the national forest system. The Forest Service provided two separate Roadless Area Review Evaluations (RARE)—one in 1967, and another in 1977—which were successfully challenged under the National Environmental Policy Act (NEPA) for failure to conduct the necessary environmental impact statements (EIS).[53] As a result, the Forest Service halted roadless designations, but still informally used the term to describe areas of national forest for their own, internal inventory purposes, until the Clinton administration sought to implement a roadless rule. On January 12, 2001, the Forest Service issued its final Roadless Rule, after having completed its final EIS.[54] After several lawsuits, however, the Forest Service withdrew its Roadless Rule in 2005 for a state petitions process.[55] The State Petition Rule allowed road building and logging to continue according to local forest management plans, and established a difficult process for state governors to request new management rules for roadless areas within their states. The State Petition Rule was subsequently challenged by both environmental groups and the states for its propriety.[56] The Northern District of California set aside the new rule and then reinstated the Roadless Rule as originally instituted.[57]

During the time that the Forest Service was trying to develop its Roadless Rule, the concept of "old-growth" stands were developed by the Forest Service, and included criteria, among others, such as stand age, dominant species in order to help them distinguish areas for wilderness designation (Hilbert and Wiensczyk 2007). The Forest Service has allowed for a flexible definition for "old-growth" forests based upon considerations of all the different statutes passed by Congress that address federal forest management. One of the more recent federal statutes, the Healthy Forest Restoration Act of 200X (HFRA), provides an example of how the Forest Service goes about determining "old growth" and subsequent protections.[58] Congress enacted HFRA following increased build-up of biomass and wildfires in early 2000 to allow for increased forestry management while preserving old-growth.[59] Congress left the definition of "old-growth" to the Forest Service to determine.[60] As a result, the Forest Service has developed regional definitions to describe old-growth in accordance with regional forest

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[47] *Id.*
[48] *Id.* at 21164.
[49] *Id.* at 21212; 39 C.F.R. § 219.9.
[50] *Id.*
[51] *Id.*
[52] 16 USC. §§ 1278–1287.
[53] Wyo. Outdoor Coordinating Council v. Butz, 484 F.2d 1244 (10th Cir. 1973) (invalidating the first RARE); California v. Block,690 F.2d 753, 758 (9th Cir. 1982) (invalidating the second RARE).
[54] 66 Fed. Reg. 3244 (Jan. 12, 2001).
[55] Wyoming v. USDA, 414 F.3d 1207 (10th Cir. 2005).
[56] See California ex rel. Lockyer v. USDA, 459 F. Supp. 2d 874 (N.D. Cal. 2006).
[57] *Id.* at 919.
[58] *See* Old-growth and Large-Tree retention, USDA website; NFMA, Wilderness Act, ESA;
[59] Douglas W. MacCleery , USDA Forest Service, The Healthy Forest Restoration Act, in
[60] Old-growth and Large-Tree retention, USDA website

composition.[61] Foresters consider primarily structural features of a forest—such as tree species, tree age, soil condition, associated life-forms within the forest, presence of dead and downed trees, canopy cover, and amount of new growth.[62] Without flexibility, a rigid definition could end up conflicting with one or many other statutory provisions. While working definitions of old-growth forests provide guidance for foresters, they have already been legally challenged under various circumstances by environmental groups. Courts have found that where definitions of old-growth were developed arbitrarily, the could would invalidate a proposed harvest,[63] but where the Forest Service developed definitions using appropriate considerations of forest tree species, tree age, and other structural features, the courts give the Service wide latitude.[64]

When considering the importance of species conservation and biodiversity,[65] the legal definitions of old-growth forest must also consider habitat requirements of species qualified for protection under the Environmental Species Act (ESA).[66] The ESA, like NEPA, must be considered in any agency decision making process where its provisions may be implicated. Many old-growth stands have ecological importance for species that are endangered.[67] If a species is found to be endangered, both the species and the critical habitat necessary for the species' survival must be protected.[68] Threatened species also receive a level of protection, but less than those species which are endangered.[69] Because the designation of a forest stand as "old-growth" impacts the manner in which the Forest Service manages a forest stand, working definitions of old-growth must consider the species within a given stand when changing designations from old-growth to some other category.[70]

The ESA, however, does not necessarily provide a guaranteed barrier to forestry management practices allowing timber harvest from old-growth stands. In a recent Ninth Circuit Court decision, the court had to consider whether the Forest Service followed the proper procedure to authorize a timber sale from area designated as critical habitat for the Northern Spotted Owl.[71] The court indicated that under ESA, formal evaluations of cumulative effect on critical habitat would only be triggered where agencies disagreed on the effect.[72] As a result, the timber harvest in area that was considered "critical habitat" for the Northern Spotted Owl was allowed to proceed according to Forest Service management plan approval.[73]

While many of the federal laws discussed act as tools to help in the preservation and conservation of biodiversity, there has been no development of a measuring scale to provide a clear determination of which forestry areas must remain untouched. Arguably, under HFRA, forestry management practices may dictate that timber harvest occur in wilderness, roadless, and even critical habitat areas from time-to-time. Designation as "wilderness area" enters a

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[61] *See* Idaho Sporting Congress v. Rittenhouse, 305 F.3d 957 (2002) (indicating that the Forest Service has regional definitions).
[62] US FOREST SERVICE *New Findings About Old-growth*, PNW Science Update No. 4 (June 2003),; *see also* Glen Gaines et al., *Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region*, US Forest Service, Southern Region Office, *available at* http://www.fs.fed.us/r8/planning/R8%20Old%20Growth%20Report.pdf
[63] Idaho Sporting Congress v. Rittenhouse, 305 F.3d 957 (2002).
[64] Krichbaum v. US Forest Service, 973 F. Supp. 585 (1997).
[65] Found to be integral to the old-growth definitional considerations in cases such as Idaho Sporting Congress v. Rittenhouse, 305 F.3d 957 (2002).
[66] Endangered Species Act of 1973, 16 USC. §§ 1531–1544 (2012).
[67] *See, e.g.*, Ethics and Spotted Owl Controversy
[68] Endangered Species Act of 1973, 16 USC. §§ 1531–1544 (2012).
[69] *Id.*
[70] *Id.*
[71] Conservation Congress v. US Forest Service, 2013 WL 2631449 (9th Circuit).
[72] *Id.*
[73] *Id.*

particular forest stand into the federal system of management under federal rules, but management plans for those forests may allow certain portions of wilderness forests to be harvested where management practices do not destroy critical habitat for threatened or endangered species. Consequently, a designation of old-growth or roadless for purposes of planning and inventory does not exempt forests from potential timber harvest, though it may increase procedural requirements before a harvest in such areas can occur, such as those included in environmental review under NEPA.

State Lands

Perhaps in response to what may be seen as inadequate protection for forest, habitat and biodiversity conservation by private land owners, some states have used their sovereign authority over land use decisions to bolster forest preservation through the implementation of such methods as management education, tax incentives, and conservation easements. Federal law can apply even on these private lands, however, when private landowners avail themselves of federal funding for forest management, under the Forest Stewardship Program (FSP). The FSP and accompanying federal monies are administered through state agencies. Much like when participating in state forest preservation programs, participants must apply, and if accepted, comply with provisions of the program in order to obtain funding to assist them in their forestry stewardship. Private landowners must develop a forest stewardship plan for their privately owned forests in compliance with FSP, as well as state requirements, to be eligible for funds. These funds assist private landowners in implementing their stewardship plans in accordance with federal policies. Where landowners have received federal funding, state policies for forest preservation may experience varying degrees of influence.

Other efforts by states to increase forest conservation appear in renewable portfolio standards (RPS). Most states have developed RPS policies to increase electrical generation through renewable resources in order to reduce greenhouse gas (GHG) emissions.[74] Exclusion of old-growth forest as a "renewable biomass" is sound as a matter of policy because many of these forests with unique characteristics, habitats and species may not be "renewable" should permanent ecological damage result from biomass harvest. However, as the following sections point out, some state RPSs include explicit references to old-growth forests and exclude them from eligible biomass, however, many do not. Moreover, inclusion of the term "old-growth" does not provide adequate direction for sustainable biomass development. Many states would benefit from an inclusion of multi-policy considerations when seeking to balance environmental conservation, reduction in GHG emissions, and implementation of sustainable biomass.

Georgia

Georgia has used some of these approaches to increase the availability of forest for environmentally important working forests.[75] Seventy percent of the land in Georgia is owned by private citizens.[76] Georgia works with private landowners who enter into a conservation easement, or otherwise donate their property to the state, to ensure forest preservation.[77] In some cases, these landowners are entitled to receive tax credits.[78] Georgia's Working Forest

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[74] *Most States Have Renewable Portfolio Standards*, US EIA (Feb. 3, 2012), http://www.eia.gov/todayinenergy/detail.cfm?id=4850 (last accessed June 17, 2013).
[75] http://www.gfc.state.ga.us/forest-management/private-forest-management/landowner-programs/forest-legacy/
[76] FOREST LEGACY PROGRAM ASSESSMENT OF NEEDS FOR THE STATE OF GEORGIA, *available at* http://www.gfc.state.ga.us/forest-management/private-forest-management/landowner-programs/forest-legacy/AssessmentofNeeds.pdf
[77] *Id.*
[78] *Id.*

Conservation Easements (WFCE) not only limit the landowner's rights, but also provide guidance on forest management to protect specified forest values.[79] WFCEs can further protect property-specific forest values by prohibiting certain forest practices, while encouraging practices that promote desired forest types.[80] WFCEs can also protect landscape values by encouraging management of a forest in relation to its surroundings, addressing sustainable forest economy and productivity, while allowing landowners to continue to derive economic value from their land.[81]

Georgia currently has no RPS in place, but has recently proposed legislation that seeks to implement one.[82] Georgia House Bill 503 (H.B. 503) from 2013 proposes to establish a state RPS.[83] Within H.B. 503, the definition of renewable energy specifically excludes biomass that has come from "old-growth timber."[84] Unfortunately, old-growth timber is not defined within the proposed legislation, nor is it defined elsewhere in Georgia statutes or regulations.

New York

In an effort to increase preservation of state-owned forests with special significance, New York has implemented laws that provide a working definition for old-growth forests. In this definition, old-growth is defined as "a parcel of at least ten acres which includes all of the following: an abundance of late successional tree species, at least one hundred eighty to two hundred years of age in a contiguous forested landscape that has evolved and reproduced itself naturally, with the capacity for self-perpetuation, arranged in a stratified forest structure consisting of multiple growth layers throughout the canopy and forest floor, featuring canopy gaps formed by natural disturbances creating an uneven canopy and a conspicuous absence of multiple stemmed trees and coppices."[85] New York also indicates that a typical old-growth forest usually have an irregular forest floor of coarse woody materials, which are often covered by mosses and lichens, exhibit limited signs of post-European human disturbance, possess distinct soil horizons, and have "an understory that displays well developed and diverse surface herbaceous layers."[86]

New York's definition of old-growth provides very explicit guidance for structural characteristics found in old-growth forests for preservation purposes. It is not clear, however, whether the definition applies to New York's carbon trading program, aimed at reducing GHG emissions, that makes reference to old-growth timber.[87] The regulations for carbon trading do not explicitly integrate the definition from the statute and fail to define what old-growth timber is for the sake of the regulations, although it does reference "old-growth." This failure to explicitly define what old-growth timber—though unlikely—could lead to the inclusion of old-growth forest biomass being used to meet state RPS.

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[79] *Id.*
[80] *Id.*
[81] *Id.*
[82] 2013 Georgia H.B. No. 503
[83] *See id.*
[84] *See id.* § 1 (proposed addition § 46-3-71(6)) (defining "renewable energy").
[85] N.Y. Envtl. Conserv. Law § 45-0105(6) (McKinney)
[86] *Id.*
[87] For carbon trading purposes, New York defines eligible biomass as including "sustainably harvested woody and herbaceous fuel sources that are available on a renewable or recurring basis (excluding old-growth timber), including dedicated energy crops and trees, agricultural food and feed crop residues, aquatic plants, unadulterated wood and wood residues, animal wastes, other clean organic wastes not mixed with other solid wastes, and biogas, derived from such fuel sources. Liquid biofuels do not qualify as eligible biomass. Sustainably harvested will be determined by the department." N.Y. Comp. Codes R. & Regs. tit. 6, § 242-1.2.

Massachusetts

Massachusetts, through administrative policy, has developed a definition of old-growth for general environmental and ecological preservation.[88] Under its policy, old-growth forests are those that are in stands of trees greater than five to ten acres in area, with no significant sign of human post-European settlement disturbances, with a component of trees that are greater than fifty percent of the maximum longevity for the particular species, and with a component of younger trees that are filling in the gaps created by natural aging and loss of the older trees.[89] Recent legislation, however, seeks to solidify the definition of old-growth found only in administrative policy by giving the policy definition more clarity and a more clear force of law.[90] Yet, much like the problems found in Georgia and New York, definitional clarity is lacking when attempting to discern application across state forest and biomass policies.

Massachusetts under its new RPS rule defines eligible woody biomass,[91] but provides no reference to old-growth forests. The Massachusetts RPS provides that eligible woody biomass may come from such sources as forest-derived residues, forest-derived thinnings and forest salvage.[92] The rule—based in part on the Manomet Study—provides a method to include sustainable harvests, which requires certification of forest-derived residues and thinnings through the Massachusetts Department of Energy Resources (MDOER).[93] Certification through MDOER also requires a report to detail the exact source of the biomass. Reporting requirements prevent prohibited material or materials in prohibited amounts from entering the supply chain, including material from old-growth forests stands.

The Council for Sustainable Biomass Production (CSBP) experience

In the absence of state regulation, which varies in its rigorousness from state-to-state as demonstrated above, private forest landowners–who own the majority of forestland in the US– are not without some tools that would guide an assessment of "naturalness" and measures to implement protections for high-value ecosystems and habitats. Experience from the Council for Sustainable Biomass Production (CSBP) standard-building activities informs greatly the challenges ahead in operationalizing those tools to satisfy environmental groups' concern that destructive conversion will occur. The proposal for forestland conversion discussed for incorporation in a CSBP integrated agricultural-forestry standard is attached in Annex A. The proposal highlights several challenges that center on the gradient between natural, semi-natural, and plantations in relation to conversion. Ultimately, if a standard is to prevent conversion, it must be able to define what conversion means. CSBP proposed to define conversion as: modifications to the structure and function of a forest, as a result of management activities, resulting in a significant reduction in the complexity of the forest system; or, the transformation of a natural or semi-natural (excluding significantly degraded semi-natural stands) forest into permanently non-forested areas or into a plantation.

CSBP was unable to further define "reduction in complexity" or otherwise develop guidance regarding how to operationalize assessment of ecosystem complexity for obvious reasons–ecosystem complexity is not well-understood enough to allow for standards to be built that find the optimum middle ground between forest owners and environmental groups. Environmental groups, at a minimum, would demand biodiversity assessments not only of species protected by the Endangered Species Act, but also those at-risk species that forest

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[88] *See* Old Growth Policy, Mass. Dept. of Envt'l
[89] *See id.*; *see also* Sierra Club v. Comm'r Dept. of Envt'l Management, 791 N.E.2d 325, 330 fn 10 (Mass. S. Ct. 2003)
[90] *See* 2013 Mass. Bill H.749, *available at* https://malegislature.gov/Bills/188/House/H749.
[91] 225 C.M.R. § 14.02
[92] *Id.*
[93] *Id.* at § 14.05(8).

owners have no current obligation under law to consider. Particular pushback from forest owners occurs for assessment of aquatic species, of which tens to hundreds may exist on any individual property. Assessment capabilities do exist through NatureServe and/or state wildlife action planning, but vary from state to state. NatureServe data can be costly, and non-industrial owners must have specialized capabilities to run the software. Ecosystem complexity depends not only on identification of individual species, but also their habitat and relation to other components of the ecosystem such as watersheds and climate. Neither NatureServe nor wildlife action plans at the state level can provide this level of detail to support a finding of "complexity" at a level where environmental groups would be satisfied that a level of precaution would be in place to prevent conversion of semi-natural forests to plantations, or any forest with high conservation values.

One way in which the CSBP standard would have likely evolved to address how to define areas of high conservation value, had the parties been able to agree on foundational principles and definitions, would have been to rely on the guidance already developed for the agricultural standard for biodiversity, and water and soil quality. In this regard, agricultural producers must consult with state wildlife authorities in order to assess what level of biodiversity, from the state perspective, is present on the land, and which species outside of endangered and threatened species protections are of concern.

Policy should consider whether the definition of high conservation value should go beyond strictly carbon and wildlife values to lands whose conversion would have detrimental effects on water quality (with attendant effects on biodiversity). Some states (e.g., Massachusetts) have incorporated into their Renewable Portfolio Standard requirements that harvests not occur above 30% of available residues to protect soil quality, and by implication, water quality. Where bioenergy-specific provisions do not exist, states in degraded watersheds are beginning to put more comprehensive plans in place to reduce non-point source pollution in response to a more aggressive assertion of federal Clean Water Act powers by the Obama administration (Endres 2013). In the Mississippi watershed, Iowa recently issued voluntary guidance to agricultural producers to reduce nutrient pollution that includes scientific assessment of the value to water quality from forested riparian buffers.[94] Virginia issued in 2013 final regulations requiring agricultural operations to put resource management plans in place, including establishment of forested buffers. As certification standards such as the CSBP integrate these programs into guidance for agricultural producers, this guidance can inform determinations of what constitutes high conservation value land in the forestry context. As experience grows, forest certifiers would be able to go beyond merely the "I know it when I see it"[95] standard for identifying semi-natural and natural forests.

Another alternative, which was discussed in CSBP but the subject of disagreement among environmental groups, was the option of mitigation in the case where land proposed for conversion is "small" (to be defined) but contains isolated, but significant conservation values (either natural or semi-natural). In this case, the forest owner could seek mitigation on another property where avoiding conversion would make more a more positive environmental impact from an ecosystem perspective than avoiding conversion of the smaller property. The controversy in this case lies in making the determination of where the mitigation must occur;

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[94] Iowa Dept. of Agriculture and Land Stewardship, Iowa Nutrient Reduction Strategy: A science and technology-based framework to assess and reduce nutrients to Iowa Waters and the Gulf of Mexico (May 2013), http://www.nutrientstrategy.iastate.edu/sites/default/files/documents/NRSfull-130529.pdf.

[95] One FSC certifier stated this during the negotiations on an integrated agriculture-forest CSBP standard with regard to how identification of semi-natural areas versus plantations should be operationalized.

some environmental groups will advocate that the mitigation must be on the same property and verified by the certification. Other environmental groups will agree to mitigation either through purchase of credits in mitigation banking that is verified by another entity.

Forest sustainability and bioenergy policies in the US

In the following sections, we describe how US various policy regimes, both at the federal and state level, have been instituted to displace fossil fuels with more renewable feedstocks—including forest biomass.[96] and examine specific carve-outs in US bioenergy policy for forest protection and general SFM policies that bioenergy statutes must rely on for foundational support.

Federal Bioenergy Policy

The US maintains several federal-level programs that incentivize biomass production and consumption. These include a broad range of mandates for biofuels blending in transportation fuels, cropping subsidies, GHG reduction strategies for stationary sources, and procurement rules. Common elements focus on accounting for carbon fluxes in forests—both directly from energy biomass and indirectly from land conversion—and maintaining or enhancing forest ecosystem values.

The Renewable Fuel Standard

Congress first ordered mandatory renewable-transportation-fuels blending in 2005 and expanded the mandate in 2007 to 31 billion gallons by 202097. The program, commonly known as the Renewable Fuel Standard (RFS), prohibits sourcing of any wood-based renewable fuels from federal forests due to the environmental lobbies' fear of overharvesting on federal lands.98 The Act's definition of "renewable biomass" allows for fuels harvested from planted trees and residues from actively managed tree plantations on non-federal land cleared prior to the Act's enactment.99 Slash and pre-commercial thinnings from non-federal lands also qualify if not derived from forests with ecological communities that are critically imperiled, imperiled, or rare either globally or in states as ranked by the State Natural Heritage Program.100 RFS fuels cannot be sourced from old growth forest or late successional forest.101

In addition to sourcing restrictions, RFS-qualifying feedstocks must achieve GHG reductions below the 2005 petroleum baseline. The amount of reduction depends on the category of fuel set forth in the statute. "Renewable fuels" (corn starch based) must achieve a twenty percent reduction, "advanced biofuels" fifty percent, biomass-based diesel fifty percent, and cellulosic biofuels sixty percent102. In addition to direct measurement of field and refinery emissions, the statute requires that indirect land use change (ILUC) be included in any pathway calculation, a portion of which is derived from measurement of forest conversion induced by

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[96] See Jody M. Endres, Legitimacy, Innovation, and Harmonization: Precursors to Operationalizing Biofuels Sustainability Standards, 38 S. ILL. U. L.J. (forthcoming Fall 2012) (manuscript at 2–9), available at http://www.arb.ca.gov/fuels/lcfs/workgroups/lcfssustain/LawReviewJodyEndres10_3_12.pdf(detailing those regimes).

[97] The Energy Policy Act of 2005, Pub. L. No. 109, 119 Stat. 594, § 201(a)-(b) (codified at 42 USC. § 15801–16538 [hereinafter 2005 EPA]; Clean Air Act, 42 USC. § 7545(o) (2006).

[98] 42 USC. § 7545(o)(1)(I).

[99] Id. § 7545(o)(1)(I)(ii).

[100] Id. § 7545(o)(1)(I)(iv).

[101] Id.

[102] Id.

international commodity market price rises.103 EPA calculates ILUC through economic models that incorporate remote sensing; government data such as the US Forest Service Forest Inventory and Analysis;104 third-party research on carbon fluxes from conversion of forest stands, floors, and soils; and carbon embedded in harvested logs.105 For direct emissions, EPA uses the Department of Energy Argonne National Laboratory's GREET lifecycle analysis model, which includes forest residue and short-rotation, woody-biomass pathways.106To calculate the total carbon footprint of an individual biofuel, EPA takes direct emission numbers from the GREET model and adds them to estimates of domestic and international land use shifts from, for example, forest to cropping systems.107 Applications are pending from forest-biomass-based companies, and EPA indicates that it is working on pathways for pulp wood,108 but EPA has not issued a final pathway analysis for forest-based cellulosic fuel yet.

Obligated parties' forest-based fuels that qualify for the RFS must keep records such as maps of where the feedstock was produced and product transfer documents.109 They also must document that forest material is not derived from land converted after the Act, such as through sales records for the trees, purchasing records of inputs, written management plans, participation in government programs or third party certifications, or maintenance of infrastructures such as roads.110 In the alternative, domestic or foreign renewable fuel producers can arrange for an independent third party to conduct a compliance review or belong to an organization that conducts surveys on compliance.[111] In late 2012, EPA proposed a more rigorous third-party auditing system in response to renewable identification number (RIN) fraud that also includes ongoing monitoring of whether the feedstock qualifies as renewable biomass.[112]

The Biomass Crop Assistance Program and Forest Stewardship Management Planning

Congress coupled the RFS's increasing mandates with provisions in the 2008 Farm Bill that established the Biomass Crop Assistance Program (BCAP), the US's first subsidy program for energy biomass.[113] Material eligible for the subsidy must be "renewable biomass" and come

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[103] Id. § 7545(o)(1)(H). ILUC refers to "the theory that the use of cropland for biofuels raises food prices and thus increases the incentive to convert forests and grasslands to crop production, thereby releasing stored carbon and decreasing future carbon sequestration." Daniel A. Farber, Land Use Change, Uncertainty, and Biofuels Policy, 2011 U. ILL. L. REV. 381, 381 (2011).

[104] US FOREST SERV., US DEP'T OF AGRIC., FOREST INVENTORY AND ANALYSIS: FISCAL YEAR 2011 BUSINESS REPORT 3 (2012), available at http://www.fia.fs.fed.us/library/bus-orgdocuments/docs/2011%20FIA%20Business%20Report-opt.pdf. (stating that "since 1930," the Forest Service has conducted an annual census to "collect, analyze, and report information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, and how it is changing, as well as how the trees and other forest vegetation are growing, how much has died or been removed, and how the harvested trees are used in recent years").

[105] See US ENVTL. PROT. AGENCY, RENEWABLE FUEL STANDARD PROGRAM (RFS2) REGULATORY IMPACT ANALYSIS 355–57, 468–490 (2010), available at http://www.epa.gov/otaq/renewablefuels/420r10006.pdf. The RFS2 Analysis also explains the methodologies for domestic and international land use change and direct process emissions, and it uses those methodologies to determine LCAs for various fuels). Id. at 355–446, 468–90.

[106] GREET Model (The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model), ARGONNE NAT'L LAB., http://greet.es.anl.gov/ (last visited Jan. 26, 2013).

[107] Id.

[108] Guidance on New Fuel Pathway Approval Process, US ENVTL. PROT. AGENCY, http://www.epa.gov/otaq/fuels/renewablefuels/compliancehelp/rfs2-lca-pathways.htm (last visited Jan. 29, 2013).

[109] 40 C.F.R. § 80.1454(d)(1)(i)–(ii)(2012).

[110] Id. § 80.1454(d)(2)(i)–(vi).

[111] Id. § 80.1454(h)(1).

[112] US ENVTL. PROT. AGENCY, EPA-420-B-12-063, PUBLIC RELEASE OF DRAFT QUALITY ASSURANCE PLAN REQUIREMENTS, (2012).

[113] Food, Conservation, and Energy Act of 2008, 7 USC. § 8111 [hereinafter 2008 Farm Bill].

from "eligible land," which includes non-industrial private forest lands but excludes federal- or state-owned land.[114] The statute dictates that successful candidates assess, among other factors, their impacts on soil, water, and related resources,[115] but it does not elaborate how except that a recipient maintain a forest stewardship management plan or the equivalent.[116] When initially rolled out in 2010, many payments went for the collection, harvest, storage, and transportation (CHST) of forest materials that otherwise would have been used to co-fire lumber mills.[117] This drew the ire of value-added industries, such as mulch and particle board, because the subsidy is paid only if destined for a bioenergy conversion facility.[118] Thus, these industries could not compete against the increased demand. The Final Rule eliminated CHST payments and added a provision that the subsidy cannot go to forest material that has a higher value in a local market.[119] The only forest-related project areas chosen for the subsidy (e.g., a payment for establishment and growing of crops) thus far involve only short-rotation woody biomass.[120]

The Federal Cooperative Forestry Assistance Act and its amendments establish and funds forest stewardship management planning generally.[121] Private forest owners receive funding to create forest stewardship management plans.[122] To receive funding, owners must adhere to US Forest Service standards.[123] These include the requirement that the plan consider, describe, and evaluate resource elements present, which run the gamut from soil, water, and biodiversity, among others.[124]

Outside of the BCAP context, one of the public benefits the Federal Cooperative Forestry Assistance program anticipates is production of renewable energy.[125] To achieve bioenergy goals, forest owners must implement a plan according to National Association of State Foresters' (NASF) guidelines.[126] NASF guidelines address several aspects of sustainability and encourage participation in carbon and woody biomass markets.[127] At a minimum, federal guidelines require that a professional resource manager prepare the plans or verify that they meet the minimum standards and a state forester must approve them.[128] Plans must also state the landowner objectives, describe the current and desired condition of the forest, and delineate practices to reach those goals within a stated timeframe.[129] The landowner must

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[114] Id. § 8111 (a)(4)–(5).
[115] Id. § 8111(c)(2)(B)(vi).
[116] Id. § 8111(c)(3)(B)(iii).
[117] MEGAN STUBBS, CONG. RESEARCH SERV., R41296, BIOMASS CROP ASSISTANCE PROGRAM: STATUS AND ISSUES 9—11 (2011), available at http://www.fas.org/sgp/crs/misc/R41296.pdf.
[118] Id. at 9–10.
[119] Biomass Crop Assistance Program, 7 C.F.R. § 1450.104(b)(3)–(4) (2012).
[120] See BCAP Project Area Listing, US DEP'T OF AGRIC., http://www.fsa.usda.gov/FSA/webapp?area=home&subject=ener&topic=bcap-pjt-bloc (last modified June 14, 2012, 2:03 PM) (listing projects involving hybrid poplar trees and shrub willow); R.S. Zalesny et al., Woody Biomass from Short Rotation Energy Crops, in SUSTAINABLE PRODUCTION OF FUEL, CHEMICALS, AND FIBERS FROM WOODY BIOMASS 27, 27, 39 (American Chemical Society, 2011), available at http://www.srs.fs.usda.gov/pubs/ja/2011/ja_2011_zalesny_002.pdf (categorizing poplars and shrub willows as short rotation woody crops).
[121] Cooperative Forest Assistance Act, 16 USC. §§ 2101–2114 (2006).
[122] Id. § 2103a(a).
[123] Id. § 2103a(f); FOREST SERV., US DEP'T OF AGRIC., FOREST STEWARDSHIP PROGRAM NATIONAL STANDARDS AND GUIDELINES 4–5 (2009), http://www.fs.fed.us/spf/coop/library/fsp_standards&guidelines.pdf.
[124] FOREST SERV., US DEP'T OF AGRIC., supra note 62, at 6.
[125] Id. at 4.
[126] Id. at 5.
[127] NAT'L ASS'N OF STATE FORESTERS, STEWARDSHIP HANDBOOK FOR FAMILY FOREST OWNERS 1 (2009), available at http://www.stateforesters.org/files/NASF-Stewardship-Handbookprint.pdf.
[128] FOREST SERV., US DEP'T OF AGRIC.., supra note 62, at 5.
[129] Id

suggest monitoring activities and demonstrate compliance with applicable laws.[130] State forestry officials also must demonstrate that monitoring programs are in place.[131] Amendments to the Forestry Assistance Act in the 2008 Farm Bill also require states to undertake a comprehensive assessment of their forest resources and priority areas, develop a strategy to address priority areas, and update the assessment every five years.[132] At least in theory, state-level assessment efforts could be used to coordinate individual funding to achieve ecosystem values that transcend individual landowner boundaries.

The Regional Forester, or Area or Institute Director, periodically monitors compliance by randomly sampling participants.[133] The requirement for a forest stewardship management plan therefore is not one rooted in regular audits or verification, and it is unclear whether BCAP administrators will regularly audit compliance with such a plan. If USDA's policy for audits of conservation planning in the agricultural landscape is any indication, it is unlikely that regular audits will occur.[134] Instead, producers will be randomly selected for SFM verification.

The Clean Air Act GHG Tailoring Rule

Although not a bioenergy policy per se, the US Supreme Court's landmark 2007 decision in Massachusetts v. EPA gave the green light to rulemaking under the CAA to curtail GHG emissions from major stationary sources.[135] Under what is known as the Title V and Prevention of Significant Deterioration (PSD) Tailoring Rule, EPA has set GHG limits on major sources, including coal-fired power plants.[136] Its final rule did not assign a GHG footprint to "biogenic carbon."[137] Instead, in July 2010, EPA issued a Call for Information soliciting comments from the public and interestingly expanded its consideration to other sustainability considerations.[138] With specific regard to forest biomass, EPA asked "what specific indicators would be useful" in determining whether it could be classified as "renewable" or "sustainable."[139]

In August of that year, the National Association of Forest Owners (NAFO) petitioned EPA to reconsider the Final Tailoring Rule's (non-) position on biogenic carbon to one that excluded

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[130] Id.
[131] Id. at 9.
[132] 2008 Farm Bill, 16 USC. §§ 2101, 2103, 2109, 2113 (2006); US FOREST SERV., US DEP'T OF AGRIC., FARM BILL REQUIREMENT & REDESIGN COMPONENTS: STATE ASSESSMENTS & RESOURCE STRATEGIES FINAL GUIDANCE 4 (2008), available at http://www.fs.fed.us/spf/redesign/state_assess_strategies.pdf.
[133] FOREST SERV., US DEP'T OF AGRIC.., supra note 71, at 8.
[134] See US GOV'T ACCOUNTING OFFICE, AGRICULTURAL CONSERVATION: USDA NEEDS TO BETTER ENSURE PROTECTION OF HIGHLY ERODIBLE CROPLAND AND WETLANDS 4 (2003), available at http://www.gao.gov/assets/240/237878.pdf (noting that National Resource Conservation Service's field offices implement conservation provisions inconsistently, thus making it more likely that farmers will receive payments despite impermissibly high erosion rates on their land).
[135] Massachusetts v. EPA, 549 US 497, 528 (2007).
[136] See generally New Source Review: Clean Air Act Permitting for Greenhouse Gases, US ENVTL;. PROT. AGENCY, http://www.epa.gov/nsr/ghgpermitting.html (last updated Dec. 5, 2012) (explaining CAA permitting programs covering GHG emissions).
[137] Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31514, 31590–91 (June 3, 2010), available at http://www.epa.gov/NSR/actions.html#mar11.
[138] See Call for Information: Information on Greenhouse Gas Emissions Associated with Bioenergy and Other Biogenic Sources, 75 Fed. Reg. 41,173, 41,173– 77 (July, 15, 2010), available at http://www.epa.gov/climatechange/Downloads/ghgemissions/Biogenic_GHG_Srcs_CFI_7.15.10_FR.pd f. (soliciting "information and viewpoints from interested parties on approaches to accounting for greenhouse gas emissions from bioenergy and other biogenic sources").
[139] Id. at 41,176.

biomass from GHG permitting because of its carbon neutrality.[140] Because EPA had received comments to the contrary—that biomass actually increased GHG emissions when taking into account indirect land use change (ILUC) —EPA granted NAFO's petition only to the extent that EPA will defer permitting of biomass-based emissions for three years while it studies carbon accounting methodologies.[141]

EPA states in the deferral that it considers forest sustainability outside the scope of the deferral, but it did charge a Scientific Advisory Board (SAB) to review its proposed accounting framework issued in September 2011.[142] The Framework acknowledges that EPA should account for ways in which forest sustainability certification can verify that land is managed to maintain or increase carbon stock.[143] While EPA does not consider sustainability factors beyond carbon, such as biodiversity or water quality, the fact that certification would qualify as a formal means to track GHG emissions would necessarily mean that management would have to meet biodiversity and water quality requirements. The SAB's last working draft, which all but one member agreed to, eliminates its formal recommendation of certification as an option because "such systems could also encounter many of the same data, scientific and implementation problems."[144] USDA and the forest industry pushed against certification in comments to the proceedings due to cost,[145] while others pointed out that certification provides real-time, on-the-ground data on management practices versus the theoretical, aggregated data that underlies GHG models that the panel was considering.[146]
Curiously, the ILUC controversy that has plagued the RFS and California Low Carbon Fuel Standard (LCFS) was not nearly as pronounced during SAB hearings. This is perhaps because environmental groups are litigating the three-year deferral in the Federal Court of Appeals for the D.C. Circuit.[147] EPA contends that as part of its overall, incremental "tailoring" process, the CAA does not prohibit it from deferring permitting of biogenic combustion pending further scientific review.[148] Environmentalists disagree that any type of de minimis or "one-step-at-a-

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[140] National Alliance of Forest Owners' Petition to Reconsider the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule and to Stay the Rule Pending Reconsideration 14 (Jul. 30, 2010), available at http://www.sidley.com/files/News/4952ec85-a991-4cb8-8f6f0ec018cd928c/Presentation/NewsAttachment/af86db7a-0e51-4091-a2bd123589ec2138/Final%20Petition%20for%20Reconsideration%20Tailoring%20Rule.pdf.

[141] See 40 C.F.R § 71.2 (2012) (defining "subject to regulation" so that, prior to July 21, 2014, GHG shall not include carbon dioxide emissions from biomass, effective on July 20, 2011); see also Deferral for CO2 Emissions From Bioenergy and Other Biogenic Sources Under the Prevention of Significant Deterioration (PSD) and Title V Programs, 76 Fed. Reg. 43490, 43492 (July 20, 2011) (noting that the three-year deferral will allow EPA to examine the science of accounting for carbon dioxide from biomass).

[142] US ENVTL. PROT. AGENCY, ACCOUNTING FRAMEWORK FOR BIOGENIC CO2 EMISSIONS FROM STATIONARY SOURCES iv (2011), available at http://www.epa.gov/climatechange/Downloads/ghgemissions/Biogenic-CO2-Accounting-FrameworkReport-Sept-2011.pdf

[143] Id. at v.

[144] US ENVTL. PROT. AGENCY, SCIENCE ADVISORY BOARD, SAB DRAFT REVIEW OF EPS'S ACCOUNTING FRAMEWORK FOR BIOGENIC CO2 EMISSIONS FROM STATIONARY SOURCES,9 (2011) http://yosemite.epa.gov/sab/SABPRODUCT.NSF/ea5d9a9b55cc319285256cbd005a472e/fbe57e198002616185257a0d0047f01f/$FILE/5-29 12%20Advisory%20with%20Track%20Changes.pdf.

[145] Letter from William Hohenstein, Dir., Climate Change Program Office, US Dep't of Agric., to Dr. Holly Stallworth, Designated Fed. Official, Sci. Advisory Bd., US EPA (May 25, 2012), available at http://yosemite.epa.gov/sab/sabproduct.nsf/F6C9D838DF864B8685257A09006F3D16/$File/USDA+CCPO+Comments+-+Hohenstein+5-25-12.pdf.

[146] Jody Endres, Letter to the SAB (May 23, 2012), http://yosemite.epa.gov/sab/sabproduct.nsf/D9CF6AF96AE9EE3685257A0800492C5F/$File/Jody+Endres+5_23_12.pdf.

[147] Ctr. for Biological Diversity v. EPA, No. 11-1101 (consolidated) (D.C. Cir. Filed Mar. 16, 2012).

[148] Final Brief of Respondents at 6–7, Ctr. for Biological Diversity v. EPA, No. 11-1101 (consolidated) (D.C. Cir. Jul. 23, 2012).

time" doctrine applies.[149] The case is currently pending for decision, but the same court has upheld EPA's other incremental implementation of the Tailoring Rule.[150]

Prior to the finality of the deferral, EPA issued guidance for determining Best Available Control Technology (BACT) for any facility that applied for a permit.[151] Interestingly, the guidance includes a requirement that permitting authorities "consider the economic, energy, and environmental impacts arising from each option ... under consideration."[152] These include environmental impacts such as "potential sequestration of carbon in biogenic resources outside the boundaries of the facility."[153] One way in which a permittee could demonstrate net sequestration off-site for purposes of BACT, as recognized by the SAB, would be through feedstock suppliers' certification that documents accompanying benefits to soil, water quality, and biodiversity.[154] The bottom line on GHG stationary source permitting under the CAA is that sustainability certification for biodiversity and other environmental protection, and accounting for GHG emissions, is undecided. Based on EPA's GHG accounting framework and my observations at SAB hearings, however, it is unlikely that EPA will ultimately couple sustainability certification with accounting for a forest's carbon footprint.

Federal Procurement

Bioenergy has the potential to satisfy a significant portion of federal procurement needs, and vice versa federal procurement rules will undoubtedly incentivize biomass-based energy and products. All agencies must have plans in place to achieve GHG reductions to 2008 levels by 2020, including through fleet and other purchases.[155] In addition to GHG reduction, all executive agencies follow the Federal Acquisition Regulation (FAR) to make "sustainable acquisitions."[156] Ninety-five percent of new contract actions must require that the product is, among other qualities, water efficient, biobased, and environmentally preferable.[157] Products qualifying under the FAR include USDA's biobased program and EPA's Environmentally Preferable Purchasing guidelines.

The Farm Security and Rural Investment Act of 2002 (FSRIA) established the program for the federal procurement of biobased products.[158] Under the Act, each agency must establish affirmative procurement programs (APPs), otherwise known as green purchasing plans (GPPs) of biobased products.[159] USDA and EPA both maintain guidelines regarding what products may qualify.[160] EPA's Final Guidance on Environmentally Preferable Purchasing is based on the goal

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[149] Final Opening Brief of Petitioners (corrected) at 19-20, Ctr. for Biological Diversity v. EPA, No. 11-1101 (consolidated) (D.C. Cir. Jul. 24, 2012).
[150] Coal. for Responsible Regulation, Inc., v. EPA, 684 F.3d 102, 148 (D.C. Cir. 2012).
[151] See OFFICE OF AIR & RADIATION, US ENVTL. PROT. AGENCY, GUIDANCE FOR DETERMINING BEST AVAILABLE CONTROL TECHNOLOGY FOR REDUCING CARBON DIOXIDE EMISSIONS FROM BIOENERGY PRODUCTION 3–5 (2011), available at http://www.epa.gov/nsr/ghgdocs/bioenergyguidance.pdf (providing overview and purpose of guidance material provided).
[152] Id. at 17.
[153] Id. at 21.
[154] See id. at 21–23 (discussing the accounting of net atmospheric GHG impact of proposed facilities using certain feedstocks).
[155] Exec. Order No. 13514, 74 Fed. Reg. 194, 52117 (Oct. 8, 2009).
[156] 48 C.F.R. § 23.000, 103 (2011).
[157] Id. § 23.103.
[158] 7 USC. § 8102 (2006).
[159] OFFICE OF FED. PROCUREMENT POLICY, REPORT ON AGENCY IMPLEMENTATION OF BUYRECYCLED AND BUY-BIOBASED PRODUCTS IN THE RESOURCE RECOVERY AND RECOVERY ACT AND FARM SECURITY AND RURAL INVESTMENT ACT 1–2 (2009), available at http://www.whitehouse.gov/sites/default/files/omb/assets/procurement_green/rcra_and_fsria_rtpdf.
[160] Id. at 1.

of pollution prevention by considering multiple attributes from a lifecycle perspective.[161] The Guidance states that there is no "hierarchy that ranks the attributes or environmental impacts that are most important," but agencies consider factors like recovery time and geographic scale, differences between competing products, and human health.[162] Although sustainability certification is not required, it is one way that federal officials can evaluate a product for qualification.[163] The Guidance also maintains an annex with a list of "environmental attributes" including ecosystem impacts and water consumption and pollution.[164]

USDA's Guidelines for Designating Biobased Products for Federal Procurement, on the other hand, forbid a procuring agency from requesting more information required of other vendors, but "encourages" them to provide information on environmental and public health benefits based on "industry accepted analytical approaches" such as ASTM D7075 and ISO 14040.[165] Biobased products do not include electricity or motor fuels and will not be designated if the product has a mature market (like fuels and electricity).[166] Two Congressmen recently introduced the Forest Products Fairness Act of 2012 that would open up the program to forest-based products regardless of market maturity, including pellets.[167] The Bill, however, contained no SFM reference.

Congress in 2008 required the Department of Defense to study ways that alternative fuels could be used to reduce GHG emissions.[168] The study concluded that it remains uncertain whether alternative fuels can be produced sustainably.[169] Its recent Request for Proposals to supply biofuels, however, stipulates that only "renewable biomass" as defined by BCAP and the 2008 Farm Bill qualify,[170] and an awardee must demonstrate sustainable practices and lifecycle GHG reduction.[171]

The role of government SFM policy in achieving bioenergy sustainability

The previous sections demonstrate that policymakers certainly have SFM on their radar screens when designing bioenergy policy, although exactly how SFM is achieved and monitored often remains unanswered. Thus, one of the key debates surrounding forests' role in bioenergy systems will be how existing government policies will adequately protect forest ecosystems and carbon sequestration in light of increased bioenergy demand. The following Sections seek answers within both federal and state SFM policies.

Federal SFM Policy

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[161] Id. at 2.
[162] Final Guidance on Environmentally Preferable Purchasing: Notice, 64 Fed. Reg. 45810, 45822–24 (Aug. 20, 1999).
[163] Id. at 45825.
[164] Id. at 45840.
[165] Guidelines for Designating Biobased Products for Federal Procurement, 77 Fed. Reg. 25632, 25641 (May 1, 2012) (to be codified at 7 C.F.R. § 3201.8).
[166] 7 C.F.R. § 3201.5 (2012) (concerning item designation).
[167] Forest Products Fairness Act of 2012, H.R. 5873, 112th Cong. (2012).
[168] See Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Pub. L. No. 110-417, § 334, 122 Stat. 4356, 4421–22, (2008) (mandating a study on clean energy alternatives for reducing carbon emissions).
[169] JAMES T. BARTIS & LAWRENCE VAN BIBBER, RAND NATIONAL DEFENSE RESEARCH INSTITUTE, ALTERNATIVE FUELS FOR MILITARY APPLICATIONS 65 (2011), available at http://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG969.pdf.
[170] US DEP'T OF DEFENSE, Funding Opportunity Announcement: Defense Production Act Title III Advanced Drop-In Biofuel Production Project 18, 22 (Jun. 27, 2012), available at https://www.fbo.gov/utils/view?id=d786f3e7ee8301999b512409757cdfbe.
[171] Id. at apps.

Harvests on public lands have typically been off-limits under bioenergy laws like the RFS and BCAP, but at least one amendment has been introduced to open them to biofuels harvests in order to prevent forest fires.[172] If that occurred, the US Forest Service and Department of Interior[173] administer several pieces of general laws and rules aimed at fostering the "multiple use" of federally-owned forests.[174] These include the Forest Service Organic Administration Act establishing the Forest Service,[175] the Sustained Yield Act of 1944,[176] the Multi-Use and Sustained Yield Act of 1960 (MUSYA),[177] and the National Forest Management Act of 1976 (NFMA).[178]Environmentalists often claim that the Forest Service has pursued the concepts of "sustained yield" and "multiple use" in a way that favors harvest levels to the detriment of sustained ecological function of the forest.[179]

In addition to these federal forest-specific management policies, federal forest actions also are subject to general environmental laws such as the National Environmental Policy Act of 1969 (NEPA),[180] the Clean Water Act (CWA),[181] and the Endangered Species Act (ESA),[182] as well as administrative rules that address the extent of the public's involvement in Forest Service decision making.[183] Historically, questions have often arisen as to how environmental laws are reconciled with Forest Service rules. This very term the US Supreme Court is hearing whether CWA permitting applies to discharges from road building in national forests,[184] proving that the question of forest sustainability remains "among the most controversial natural resource management issues" in US public lands law.[185]

The National Forest Management Act (NFMA)

Although NFMA does not allow environmental values to trump economic uses of federal forests completely, NFMA does require the Forest Service to prepare management plans that provide for "sustained" yields[186] and regulations that consider plant, animal, and tree diversity.[187] The Forest Service Manual[188] and other guidance (e.g., best management practices

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[172] Thune Reintroduces Legislation to Encourage Biofuel Production from National Forests, JOHN THUNE: US SENATOR-SOUTH DAKOTA (Apr. 11, 2011), http://www.thune.senate.gov/public/index.cfm/press-releases?ID=e084223f-0ac7-40ed-b042f9dde19f77a6.

[173] HANS GREGERSEN ET AL., CTR FOR INT'L FOREST RES., FOREST GOVERNANCE IN FEDERAL SYSTEMS: AN OVERVIEW OF EXPERIENCES AND IMPLICATIONS FOR DECENTRALIZATION 38 (2004), available at http://www.forest-trends.org/documents/files/doc_122.pdf (explaining the origin of Forest Service jurisdiction); see also generally Deborah Scott & Susan Jane M. Brown, The Oregon and California Lands Act: Revisiting the Concept of "Dominant Use," 21 J. ENVTL. L. & LITIG. 259, 260 (2006) (explaining the concept of BLM jurisdiction).

[174] Robert L. Glicksman, Sustainable Federal Land Management: Protecting Ecological Integrity and Preserving Environmental Principle, 44 TULSA L. REV. 147, 147 (2008).

[175] 16 USC. §§ 473–482, 551 (2006).

[176] 16 USC. §§ 583–583i (2006).

[177] 16 USC. §§ 528–531 (2006).

[178] 16 USC. §§ 1600–1614 (2006).

[179] James Briggs, Ski Resorts and National Forests: Rethinking Forest Service Management Practices for Recreational Use, 28 B.C. ENVTL. AFF. L. REV. 79, 86–93 (2000) (detailing the history of "multiple use" and "sustained yield" and environmentalists' mounting confrontations with the Forest Service over interpretation of the terms).

[180] National Environmental Policy Act of 1969, 42 USC. §§ 4321–4347 (2006).

[181] Water Pollution Prevention and Control Act, 33 USC. §§ 1251–1387 (2006).

[182] Endangered Species Act of 1973, 16 USC. §§ 1531–1544 (2006).

[183] Appeals Reform Act, 16 USC. § 1612 (2006); 36 C.F.R. §§ 215.3(a), 218.1–218.16 (2012); Administrative Procedure Act, 5 USC. §§ 701–706 (2012).

[184] Adam Liptak, E.P.A. Rule Complicates Runoff Case for Justices, N.Y. TIMES, Dec. 3, 2012, http://www.nytimes.com/2012/12/04/us/epa-rule-complicates-supreme-court-case-on-loggingrunoff.html.

[185] Long, supra note 2, at 2.

[186] 16 USC. § 1604(e)(2) (2006).

[187] Id. § 1604(g)(3)(B).

[188] Forest Service Manual: All Issuances, US FOREST SERV., US DEP'T OF AGRIC., http://www.fs.fed.us/im/directives/dughtml/fsm.html (last modified Nov. 3, 1997).

for water quality[189]) play primary roles in implementing forest plans. Until 2012,[190] federal planning rules were based on a 1982 rule.[191] The Clinton administration proposed a revised rule in 2000, but the George W. Bush administration refused to implement the rule.[192] Instead, the Bush administration proposed its own rules twice, which essentially eliminated environmental review and gave little incentive to the Forest Service to plan for wildlife conservation.[193] Courts on both occasions struck down the rules, opening an opportunity for the Obama administration to finalize a new rule that is now in effect.[194]

Whether or not the current rule will be similarly overturned is uncertain. The Center for Biological Diversity, the organization behind the two other successful suits, has criticized the rule for weakening longstanding biodiversity protections by eliminating the requirement that the Forest Service maintain viable populations of species in favor of deference to localized decisions.[195] Instead, the rule focuses on ecosystem integrity and biodiversity that is dependent on the regional forester's discretion as to what species are of concern and whether the Forest Service has the authority and capability to maintain a viable population.[196] That does not mean the Forest Service can ignore species conservation; its plans must "maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range."[197] Conservationists argue that the rule's focus on species of concern lessens protections for all native species, and its diffusion of decision-making authority to lower levels risks capture by local economic interests.[198] The Forest Service currently maintains technical guidelines for species monitoring, but it is unclear how those might change in light of the new rule.[199]

The final rule "recognizes ... that development of renewable and non-renewable energy resources are among the potential uses in a plan area. However, the final rule does not dictate the activities that may occur or not occur on administrative units of the NFS."[200]Assessments for planning purposes must account for energy resources.[201] The extent to which those resources are accessible depends on other sustainability factors incorporated into planning, such as biodiversity and water quality conditions. New provisions contain the core sustainability metrics for forest planning, spanning ecosystem integrity, air quality, soils, and water quality. Persistent violation of state water quality standards led to an added requirement in the final rule that the Forest Service Chief promulgate national level best management practices to maintain and restore water quality and a system of ensuring that lessees implement them.[202]

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[189] US FOREST SERV., US DEP'T OF AGRIC., NATIONAL BEST MANAGEMENT PRACTICES FOR WATER QUALITY MANAGEMENT ON NATIONAL FOREST SYSTEM LANDS 7–8 (2012), available at http://www.fs.fed.us/biology/resources/pubs/watershed/FS_National_Core_BMPs_April2012.pdf. [hereinafter NATIONAL BEST MANAGEMENT PRACTICES FOR WATER QUALITY MANAGEMENT].

[190] National Forest System Land Management Planning, 36 C.F.R. § 219 (2012).

[191] Charles Davis, The Politics of Regulatory Change: National Forest Management Planning under Presidents Bill Clinton and George W. Bush, 25 REV. POL'Y RES. 37, 42 (Jan. 2008).

[192] Id. at 44

[193] Id. at 48.

[194] Juliet Eilperin, Administration Rewrites Forest Rules, WASH. POST, Jan 27, 2012, at A20.

[195] See Holly Doremus, New Forest Service Planning Rule Highlights the Tension Between Flexibility and Accountability, LEGAL PLANET (Mar. 27, 2012), http://legalplanet.wordpress.com/2012/03/27/new-forest-service-planning-rule/ (discussing negative public comments about the final rule).

[196] 36 C.F.R. § 219.9.

[197] Id.

[198] Doremus, supra note 134.

[199] PATRICIA N. MANLEY ET AL., MULTIPLE SPECIES INVENTORY AND MONITORING TECHNICAL GUIDE 1–6 (2006), available at http://www.fs.fed.us/rm/pubs_other/wo_gtr073.pdf.

[200] National Forest System Land Management Planning, 77 Fed. Reg. 21,162, 21,257 (Apr. 9, 2012) (to be codified at 36 C.F.R. pt. 219).

[201] 36 C.F.R. § 219.6(b)(10).

[202] NATIONAL BEST MANAGEMENT PRACTICES FOR WATER QUALITY MANAGEMENT, supra note 128, at 7–8.

Stewardship Contracts

Beginning in the late 1980s, the Forest Service began searching for a way to reduce its forest management costs.[203] By 2003, Congress granted the Forest Service and the BLM authority through 2013 to enter into stewardship contracts that include SFM.[204] The seven goals of stewardship contracting include: (1) maintaining or obliterating roads and trails to restore or maintain water quality; (2) soil productivity, habitat for wildlife and fisheries, or other resource values; (3) setting prescribed fires to improve the composition, structure, condition and health of stands or improve wildlife habitat; (4) removing vegetation or other activities to promote healthy forests, reduce fire hazards, or achieve other land management objectives; (5) restoring and maintaining watersheds; (6) restoring and maintaining wildlife and fish habitat; and (7) controlling noxious weeds and exotic weeds, and re-establishment of native plant species.[205] Contractors also must comply with all other applicable laws, including NEPA.[206]

To the extent that contract offerings are economically attractive to bidders, stewardship contracting could be used in federal forests to harvest energy biomass in a sustainable manner. It is unclear from public documents, however, how the goals of the program are translated to specific SFM practices on the ground, or how they are enforced or otherwise monitored.

The Healthy Forests Restoration Act

While environmentalists were successful in blocking Bush Administration changes to the NFMA forest planning rule, the administration was successful in passing the Healthy Forests Restoration Act of 2003 (HFRA).[207]The HRFA and implementing regulations attempted to create categorical exemptions from environmental review of certain activities related to preventing fires and curtailing public participation rights in decision making.[208] For example, by redefining "extraordinary circumstances" in the Forest Service Handbook, the Forest Service excluded from automatic environmental assessment the term "resource conditions" such as the presence of threatened or endangered species, wilderness or wilderness study areas, and municipal watersheds.[209]

This redefinition, in turn, provided the Forest Service with new grounds for categorical exclusions from environmental review.[210] The Forest Service also introduced new appeal procedures that severely limit the ability to stop these types of projects before they begin if, for example, done under an "emergency" to prevent economic loss or categorical exclusion.[211] Categorical exclusions include "hazardous fuels reduction and rehabilitation activities" on large

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[203] PINCHOT INST. FOR CONSERVATION, THE ROLES OF COMMUNITIES IN STEWARDSHIP CONTRACTING: FY 2011 PROGRAMMATIC MONITORING REPORT TO THE USDA FOREST SERVICE 6 (2012), available at http://www.fs.fed.us/restoration/documents/stewardship/reports/2011/FinalFY11USFSMonEvalReport.p df. (describing Stewardship contracts as service agreements with contractors that "offer discretion to contractors in how they achieve the desired end-results while working within the broad parameters established in the contracts)."

[204] Id. at 8.

[205] FOREST SERV., DEP'T OF AGRIC., FOREST SERVICE HANDBOOK, 2409.19 § 61.2 (2008), available at http://www.fs.fed.us/im/directives/fsh/2409.19/2409.19_60.doc.

[206] Id. § 60.3(2)–(3).

[207] 16 USC. § 6501 (2006).

[208] David J. Willms, The Mountain Pine Beatle: How Forest Mismanagement and a Flawed Regulatory Structure Contributed to an Uncontrollable Epidemic, 10 WYO. L. REV. 487, 502–03 (2010); Eric E. Huber, Environmental Litigation and the Healthy Forests Initiative, 29 VT. L. REV. 797, 803 (2005).

[209] Willms, supra note 147, at 503–04.

[210] Id. at 504; Huber, supra note 156, at 803.

[211] Huber, supra note 147, at 804.

tracts of forests (e.g., up to 4500 acres in some cases) and live tree harvest on up to 250 acres even with temporary road construction.[212] The Forest Service also eliminated consultation with the Fish and Wildlife Service for these projects.[213] In 2007, however, environmentalists successfully stopped these fuels-related categorical exclusions through litigation.[214] One commentator contends that until Congress exempts these projects from NEPA review directly in the HFRA, NEPA, and ESA statutes, fuels reduction projects under the HFRA will likely be subject to environmental impact assessments that can be drawn out for periods of time disproportionate to the fire danger presented by the build-up of forest fuels.[215]

Recognizing that the HFRA plays a large role in the utilization of biomass for bioenergy, the Departments of Agriculture, Interior, and Energy signed a Memorandum of Understanding in 2003 setting "Policy Principles for Woody Biomass Utilization for Restoration and Fuel Treatments On Forests, Woodlands, and Rangelands."[216] The principles include mapping of potential biomass resources and encouraging sustainable development including "sustainability measures."[217] In 2008, the Forest Service issued its "Woody Biomass Utilization Strategy," which recognizes the need to develop management practices for sustainability.[218] The Forest Service has also developed a Woody Biomass Toolkit and a Utilization Desk Guide, which recognize the environmental implications of increased harvest but do not recommend specific practices and instead rely on NEPA (and the now enjoined categorical exclusions) for environmental protection.[219]

Private Certification on Federal Lands

In 2007, the Forest Service commissioned a study gauging the effectiveness of its existing forest management practices compared to certain third-party certification standards.[220] While auditors commended the thoroughness of planning, comprehensive use of scientific data, and stakeholder engagements, shortcomings in Forest Service policy related to forest sustainability practices were found.[221] Delayed silvicultural treatments and unachieved ecological, social, and economic management goals were the primary lapses cited.[222] The report cites increased pest

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[212] Id. at 804–05.
[213] Id. at 805.
[214] Letter from Abigail R. Kimbell, US Forest Serv., District Court Issues Injunction in Sierra Club v. Bosworth, 04-2114, (E.D. Cal.) Prohibiting Use of the Hazardous Fuels Reduction Categorical Exclusion, Subject to Certain Exceptions (Dec. 1, 2008), available at http://www.fs.fed.us/emc/nepa/nepa_handbook_docs/chief_1570_memo.pdf. See also GOVERNMENT ACCOUNTABILITY OFFICE, GAO 10-337, FOREST SERVICE: INFORMATION ON APPEALS, OBJECTIONS, AND LITIGATION INVOLVING FUEL REDUCTION ACTIVITIES, FISCAL YEARS 2006 THROUGH 2008 17 (Mar. 2010), available at http://www.gao.gov/new.items/d10337.pdf (concluding that about two percent of HFRA projects were litigated by environmentalists).
[215] Willms, supra note 147, at 490, 514.
[216] US DEP'T OF AGRIC. ET AL., MEMORANDUM OF UNDERSTANDING ON POLICY PRINCIPLES FOR WOODY BIOMASS UTILIZATION FOR RESTORATION AND FUEL TREATMENTS ON FORESTS, WOODLANDS, AND RANGELANDS 1 (2003), available at http://www.fs.fed.us/woodybiomass/documents/BiomassMOU_060303_final_web.pdf.
[217] Id. at 4, 6.
[218] US FOREST SERV., US DEP'T AGRIC., WOODY BIOMASS UTILIZATION STRATEGY 2–3 (2008), available at http://www.fs.fed.us/woodybiomass/strategy/documents/FS_WoodyBiomassStrategy.pdf.
[219] BARRY WYNSMA ET AL., FOREST SERV., US DEP'T OF AGRIC., WOODY BIOMASS UTILIZATION DESK GUIDE 54-59 (2007), available at http://www.forestsandrangelands.gov/Woody_Biomass/documents/biomass_deskguide.pdf.
[220] THE PINCHOT INST. FOR CONSERVATION, NATIONAL FOREST CERTIFICATION STUDY: AN EVALUATION OF THE APPLICABILITY OF FOREST STEWARDSHIP COUNCIL (FSC) AND SUSTAINABLE FOREST INITIATIVE (SFI) STANDARDS ON FIVE NATIONAL FORESTS 6 (2007), available at http://www.fs.fed.us/projects/forestcertification/full-report.pdf.
[221] See id. at 27–29 (discussing the strengths and weaknesses of Forest Service policy when using the FSC standard).
[222] Id. at 28.

and disease infestation, increased potential for "stand-replacing" wildfire, and the inability to achieve desired forest structure and composition (e.g., bird habitat) as some of the ramifications of the failure to manage forests for sustainability.[223] The report notes that lack of financial resources and capacity have led to these delays.[224] Forest officials further admitted their inability to adequately enforce rules meant to reduce the detrimental environmental impacts of off-road vehicle use.[225] Some inadequacies related to scale and access were also found with management of late succession and old growth forests.[226]

The 2007 study reveals that public laws, standing alone, have not been enough to ensure sustainability of forest harvests in some cases. Assuming that federal forests will be opened to harvests for energy biomass,[227] to combat the threat of overharvesting for energy biomass, future general federal forest laws could require regular audits of Forest Service policies to third party certification principles, criteria and indicators, similar to the 2007 study. Alternatively, private leases in federal forests could be subject to actual third-party certification. A combination of both public and private requirements would ensure that both whole forest and site level sustainability are better achieved.

The Lacey Act and Imports from Illegal Logging

Congress passed the Lacey Act in the early 1900s as a way to prevent illegal fish and wildlife trafficking.[228] The 2008 Farm Bill expanded Lacey Act prohibitions on the interstate and international trade in illegally harvested timber under US or any foreign law covering theft, taking from protected or officially designated areas, and taking without prior authorization.[229]168 Forest-based bioenergy imported into the US is subject to the Act, which at least in theory should deter sourcing materials from illegal deforestation.[230]

All imports must file a declaration with USDA's Animal and Plant Health Inspection Service (APHIS) stating the scientific name of the tree, the quantity and value of the shipment, and the country from which the tree was taken.[231] It does not require importers to maintain a chain-of-custody regarding sustainability,[232] but it carries stiff criminal penalties if the importer knowingly sources illegally-harvested timber, including woody biomass for energy such as pellets.[233] If the producer does not knowingly import such products but fails to exercise "due care," the importer is subject to lesser misdemeanor charges and civil penalties.[234] The US Department of Justice has stated that "due care means that degree of care which a reasonably prudent person would exercise under the same or similar circumstances," and that it "is applied differently to different categories of persons with varying degrees of knowledge and

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[223] Id.
[224] Id.
[225] Id. at 29.
[226] Id.
[227] In the US, the Renewable Fuel standard's definition of "renewable biomass" does not include any materials from federal forests. See supra note 35.
[228] Rachel Salzman, Establishing a "Due Care" Standard Under the Lacey Act Amendments of 2008, 109 MICH. L. REV. FIRST IMPRESSIONS 1, 1 (2010).
[229] 2008 Farm Bill, supra note 52, § 8204 (codified as amended at 16 USC. § 3371–3372 (2006)).
[230] ENVTL. INVESTIGATION AGENCY, THE US LACEY ACT FREQUENTLY ASKED QUESTIONS ABOUT THE WORLD'S FIRST BAN ON TRADE IN ILLEGAL WOOD 1 (2007), available at http://www.eiaglobal.org/lacey/P6.EIA.LaceyReport.pdf.
[231] 170. Id.; 2008 Farm Bill, supra note 52, § 8204 (codified as amended at 16 USC. § 3372 (2006)).
[232] ANIMAL & PLANT HEALTH INSPECTION SERV., US DEP'T OF AGRIC. LACEY ACT: COMPLETE LIST OF QUESTIONS AND ANSWERS pt. 17 (2012), available at http://www.aphis.usda.gov/plant_health/lacey_act/downloads/faq.pdf.
[233] Salzman, supra note 167, at 1.
[234] Id. (citing 16 USC. § 3373(d)(2)) (2008)).

responsibility."[235] The ambiguous nature of the "due care" standard[236] has lead industry groups like the Flooring Institute to issue their own guidance that includes: a written company policy, standard operating procedures and checklists, asking suppliers to explain the due diligence they exercised in sourcing wood products, and knowing where the biomass is harvested from through third party certifications.[237]

State Bioenergy and SFM Policies

The US federalist system of government results in a patchwork of SFM regulation at the federal, state and local levels. Each state maintains its own rules for state forests and private lands within its borders.[238]Many are not biomass-specific, while others have evolved in recognition of increased biomass demand for bioenergy programs such as renewable portfolio standards (RPS).[239] The following sections highlight two states, California and Massachusetts, to demonstrate this variation in protection of forest sustainability.

California

California has the most aggressive, comprehensive set of bioenergy policies in the US, if not the entire world, much of which focuses on the reduction of GHG emissions. The Global Warming Solutions Act of 2006 created a multi-faceted regulatory program to reduce California's GHG emissions to 1990 levels by 2020, and eighty percent below 1990 levels by 2050.[240] Strategies include a Cap and Trade Program (C & T),[241] a Low Carbon Fuel Standard (LCFS),[242] a renewables portfolio standard (RPS),[243] and feed-in tariffs.[244] In addition, Assembly Bill 118 provides a funding mechanism for alternative and renewable fuel technologies that depends, in part, on the application of sustainability criteria.[245] A "Scoping Plan" guides implementation of the A.B. 32's GHG reduction goals.[246]

Regardless of the program, California recognized early on that its aggressive bioenergy policies and incentives must also take into account sustainability. As early as 2004, California

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[235] Thomas Swegle, The Lacey Act Amendments, ENV'T & NATURAL RES. DIV., US DEP'T OF JUSTICE (Sept. 23, 2009), http://www.eli.org/pdf/seminars/09.23.09dc/swegle.pdf.
175. Francis G. Tanczos, A New Crime: Possession of Wood–Remedying the Due Care Double Standard of the Revised Lacey Act, 42 RUTGERS L.J. 549, 567 (2011).
[236] Francis G. Tanczos, A New Crime: Possession of Wood–Remedying the Due Care Double Standard of the Revised Lacey Act, 42 RUTGERS L.J. 549, 567 (2011).
[237] JIM GOULD, FLOOR COVERING INST., LLC, CONTINUING WOOD TRADE UNDER THE LACEY ACT AMENDMENTS, available at http://www.floorcoveringinstitute.com/files/Lacey__Act__Article15_2.pdf. (last visited Mar. 4, 2013).
[238] See PAUL V. ELLEFSON ET AL., GOVERNMENT REGULATION OF FORESTRY PRACTICES ON PRIVATE FORESTLAND IN THE UNITED STATES: AN ASSESSMENT OF STATE GOVERNMENT RESPONSIBILITIES AND PROGRAM PERFORMANCE v–vii (2004) (providing an overview of the wide variety of state rules).
[239] See, e.g., PA. DEP'T. OF CONSERVATION & NATURAL RES., GUIDANCE ON HARVESTING WOODY BIOMASS FOR ENERGY IN PENNSYLVANIA 1 (2008), available at http://www.dcnr.state.pa.us/PA_Biomass_guidance_final.pdf.
[240] California Global Warming Solutions Act, CAL. HEALTH & SAFETY CODE §§ 38500, 38550 (West 2011); EXECUTIVE ORDER S-3-05 (June 1, 2005), available at http://gov38.ca.gov/index.php?/print-version/executive-order/1861/.
[241] CAL. CODE REGS. tit. 17, § 95801 (2013).
[242] Exec. Order S-01-07 (2007), available at http://www.arb.ca.gov/fuels/lcfs/eos0107.pdf.
[243] CAL. PUB. UTIL. CODE §§ 399.11–399.32 (2011); Sen. 107, 2006 Leg. (Cal. 2006) (increasing the mandate from 20% by 2017 to 20% by 2010); Exec. Order S-21-09 (2009), available at http://gov.ca.gov/executive-order/13269/ (increasing the amount to 33% by 2020).
[244] Assemb. B. 1969, 2006, chap. 731 (Cal.), codified at CAL. PUB. UTIL. CODE § 399.20.
[245] CAL. HEALTH & SAFETY CODE § 44272(a), (c)(3), (c)(5) (West 2012).
[246] CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN 1 (2008), available at http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.

conducted a series of baseline assessments of biomass resources in the state.[247] Further, state agencies are directed in the California RES to develop biomass plans to meet those targets through cooperation on the Bioenergy Interagency Working Group (BIWG).[248] The BIWG issued a Bioenergy Action Plan in 2006 that laid out priority areas of research for forest biomass, including: establishing demonstration forests (replanted); determining the highest market value and use potential for "forest fuel, harvest residues, and other small wood forest products" as fuel, power or chemicals; and demonstrating efficient harvesting technologies for small forests.[249] The BWWG has regularly issued Progress Reports toward these goals.[250]

The most recent, issued in 2012, recognizes that policies must be developed "to increase sustainable use of biomass residues from the forestry, agricultural, and urban sectors with safeguards to protect and restore ecosystem health."[251] It states that standards will issue by 2013.[252] In addition to the BIWG reports, the California Department of Forestry and Fire Protection recognizes in its 2010 Forests and Rangelands Assessment that "[e]merging markets for renewable energy, ecosystem services and niche products are impacting how forest and rangelands are managed," and that "[d]eveloping appropriate policies requires a better understanding of the benefits and environmental impacts of these emerging markets and how society values the various market and non-market products and services provided by forests and rangelands."[253]

The Board of Forestry and Fire Protection (BoF) has established an Interagency Forestry Working Group on Climate Change (IFWG) to lead forest-related efforts.[254] Specifically, its mission is to: improve GHG inventory of the forest sector, evaluate the adequacy of existing forest regulations and programs for achieving GHG targets, define biomass sustainability for biofuel utilization incentivized by the LCFS and A.B. 118, develop and promote incentives for private and public landowners to increase and maintain carbon stocks, and identify educational opportunities about climate change for forest landowners.[255] In March 2012, the group reported on progress toward establishing sustainability criteria.[256] The group specifically identifies its goal in this regard as "defining scientifically-based guidelines for achieving

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[247] CAL. BIOMASS COLLABORATIVE, BIOMASS RESOURCE ASSESSMENT IN CALIFORNIA (2005), available at http://www.energy.ca.gov/2005publications/CEC-500-2005-066/CEC-500-2005066-D.PDF; see also BIOMASS CHALLENGES, supra note 15, at 15 (estimating the annual available biomass in California for 2005).

[248] Exec. Order S-06-06 (2006), available at http://gov.ca.gov/executive-order/183/ (establishing biofuels targets of twenty percent by 2010, forty percent by 2025, and seventy-five percent by 2050; and, for biomass to electricity, a twenty percent target "within the established state goals for renewable generation for 2010 and 2020").

[249] BIOENERGY INTERAGENCY WORKING GRP., BIOENERGY ACTION PLAN FOR CALIFORNIA 3 (2006), available at http://www.energy.ca.gov/2006publications/CEC-600-2006-010/CEC-600-2006010.PDF.

[250] Bioenergy Action Plan, CAL. ENERGY COMM'N, http://www.energy.ca.gov/bioenergy_action_plan/ (last visited Jan. 27, 2013).

[251] BIOENERGY INTERAGENCY WORKING GRP., 2012 BIOENERGY ACTION PLAN 17 (2012), available at http://www.resources.ca.gov/docs/2012_Bioenergy_Action_Plan.pdf.

[252] Id. at 20–21.

[253] CAL. STATE BD. OF FORESTRY & FIRE PROT., CALIFORNIA'S FORESTS AND RANGELANDS: 2010 ASSESSMENT 193 (2010), available at http://frap.fire.ca.gov/assessment2010/pdfs/california_forest_assessment_nov22.pdf.

[254] CAL. STATE BD. OF FORESTRY & FIRE PROT., 2009 CHARTER, INTERAGENCY FORESTRY WORKING GROUP ON CLIMATE CHANGE 2 (2009), available at http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/mission_and_goals/charter/ifwg_charter_final4-7-09.pdf.

[255] INTERAGENCY FOREST WORKING GRP., THE EFFECTS OF FOREST AND RANGELAND REGULATIONS ON GREENHOUSE GAS GOALS 2 (2012), available at http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/current_projects/ifwg_task_2_final_3_20_12.pdf.

[256] BILL KINNEY, CAL. ENERGY COMM'N, IFWG TASK # 3—PROGRESS REPORT: PRESENTATION TO BOARD OF FORESTRY AND FIRE PROTECTION 1 (2012), available at http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/current_projects/presentation_to_the_board_february_and_march_2012/task3_bof_030712.pdf.

sustainable forest landscapes when forest biomass is utilized for biofuels—in terms of resiliency from disease, drought and fire; ecological function and health; and biological productivity."[257] It also indicates that it will focus on economic and social sustainability[258] and is conducting public outreach and research (including pilot-scale case studies) that will lead to strategies that address the three tenets of sustainability.[259]198 Understandably, its research has centered on wildfires and the impact of fuel treatments (which can be used as feedstocks for fuels) on wildlife and biodiversity, water quality, soils, and nutrient cycling.[260] Lastly, it is applying lifecycle analysis to compare various treatment strategies and "[b]enchmarking state and federal management guidelines with 3rd party forest certification systems and protocols."[261]

The Low Carbon Fuel Standard (LCFS)

The LCFS requires fuel suppliers to reduce the carbon intensity of their entire portfolio each year relative to the 2006 petroleum baseline, with the goal of reducing the overall intensity of California's transportation fuel supply 10 percent by 2020.[262] While this strategy differs from the RFS volumetric mandate, it still operates in the same way to incentivize forest biomass feedstocks.

Regulated parties must use LCA to determine the intensity "pathway" of each fuel they sell.[263] As with the federal RFS, no pathway has been created for forest-based fuels. ARB relies on GREET for direct emissions calculations and incorporates ILUC into fuel footprints.[264] With regard to other sustainability factors, throughout 2011–2012 the Air Resources Board (ARB) has convened workgroup meetings to discuss sustainability metrics for feedstocks converted into LCFS-qualifying fuels.[265] ARB has proposed criteria and indicators addressing soil and water quality and biodiversity protection.[266] Whether or not formal certification will be required is uncertain, particularly in light of pending litigation on the constitutionality of extending sustainability measures like LCFS carbon accounting beyond California's borders.[267] ARB and some workgroup members have emphasized that ARB must assess whether additional certification (e.g., through a private standard) beyond application of existing laws and policies is necessary.[268] This will require "benchmarking" of laws such as the Forest Practice Rules to basic concerns enumerated in the draft criteria and indicators. BoF officials routinely attend workgroup meetings, and discussions often recognize that further coordination between the LCFS working group and the IFWG will be necessary to ensure consistency in SFM initiatives.

The Cap and Trade Program, Renewables Portfolio Standard, and AB 118 Investment

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[257] Id. at 2.
[258] Id.
[259] See id. at 4.
[260] Id. at 12.
[261] Id.
[262] AIR RES. BD., CAL. ENVTL. PROT. AGENCY, LOW CARBON FUEL STANDARD: FINAL STATEMENT OF REASONS 5 (2009), available at http://www.arb.ca.gov/regact/2009/lcfs09/lcfsfsor.pdf.
[263] Id. at 15–16.
[264] Id. at 107.
[265] Low Carbon Fuel Standard Sustainability Workgroup, AIR. RES. BD., CAL. ENVTL. PROT. AGENCY, http://www.arb.ca.gov/fuels/lcfs/workgroups/lcfssustain/lcfssustain.htm (last visited Jan. 29, 2013).
[266] Id. (embedding criteria in slide presentations).
[267] See generally Jody M. Endres & Daniel Szewczyk, Carbon and the Constitution: Barriers to Lifecycle Assessment Threaten the Credibility of State Bioenergy Policies, A.B.A. ENERGY COMM. NEWSLETTER (AM. BAR ASSOC., CHI., ILL.), no. 2, May 2012, at 16 (discussing litigation claiming that carbon intensity application violates the dormant commerce clause and is preempted by federal law).
[268] Id. at 18.

California's cap-and-trade regulation exempts forest biomass-based fuels from carbon accounting if produced under a timber management plan and harvested to reduce fires or improve stands.[269] However, entities must still report volume and contact information for this biomass under the mandatory reporting regulation if a certain minimum threshold emission level is triggered.[270] Otherwise, direct emissions from combustion of non-exempt biomass falls within the cap, with carbon values calculated either using a federal GHG reporting rule methodology or those set forth in the Cap and Trade regulation[271] Aside from the timber management plan requirement, other sustainability provisions are being considered in the context of offset credits that can be generated from REDD projects.[272] Specifically, the Governors' Climate and Forests Task Force (GCF) is continuing to work on integrating sustainability mechanisms in REDD projects that qualify for the cap-and-trade program.[273]

Renewable energy credits (RECs) generated through the RPS currently lack concrete definitions of "renewability," except as broadly defined in the RPS statute as that which does not "cause or contribute to any violation of a California environmental quality standard or requirement."[274] While it remains unclear how the California Energy Commission (CEC) will verify environmental compliance, it does participate in the IFWG. The CEC recently issued a study of the lifecycle effects of certain energy systems, including one using forest maintenance feedstocks, and found significant net reductions of CO2.[275]
Some of the sustainability research conducted by the IFWG is funded through A.B. 118, passed in 2007 to advance alternative fuels and vehicle technology investment.[276] The CEC applies sustainability criteria to make A.B. 118 awards.[277] With regard to forest biomass resources, CEC's A.B. 118 regulation requires that: [p]rojects that use forest biomass resources as part of their feedstock, and that demonstrate the advancement of natural resource protection goals, are those that use forest biomass collection or harvesting practices that do not diminish the ecological values of forest stands, and that are consistent with forest restoration, fire risk management and ecosystem management goals.[278]The regulation states that preference for funding will be given to those projects that "strictly follow" third-party certification and provides examples of certification regimes including the Forest Stewardship Council.[279]

Generic Environmental Review for Forest Projects

In addition to the sustainability provisions in California's bioenergy statutes, California maintains comprehensive generic forest protection policies and carbon accounting

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[269] CAL. CODE REGS. tit. 17, § 95852.2(a)(4) (2013).
[270] CAL. CODE REGS. tit. 17, §§ 95103(j), 95852.2 (2013).
[271] CAL. CODE REGS. tit. 17, §§ 95582(i), 95752.1, 95103(j) (2013); 40 C.F.R. § 98.33 (2012) (providing federal calculation methodology for GHG emissions).
[272] See infra text and notes at 466–68.
[273] GOVERNORS' CLIMATE & FORESTS TASK FORCE, GCF DESIGN RECOMMENDATIONS FOR SUBNATIONAL REDD FRAMEWORKS 5–6 (2011), available at
http://www.gcftaskforce.org/documents/REVISED_DRAFT_Task%201_Subnational_REDD_Frameworks_Report.pdf.
[274] CAL. PUB. RES. CODE § 25741(a)(2)(B)(ii) (Supp. 2012); OFFSET QUALITY INITIATIVE, MAINTAINING CARBON MARKET INTEGRITY: WHY RENEWABLE ENERGY CERTIFICATES ARE NOT OFFSETS 2–3 (2009), available at http://www.climatetrust.org/pdfs/ JuneBrief.pdf.
[275] MARGARET K. MANN ET AL., NAT'L RENEWABLE ENERGY LAB., LIFE CYCLE ASSESSMENT OF EXISTING AND EMERGING DISTRIBUTED GENERATION TECHNOLOGIES IN CALIFORNIA 44 (2011),
available at http:// www.energy.ca.gov/2011publications/CEC-500-2011-001/CEC-500-2011-001.pdf.
[276] Assemb. B. 118, 2007, chap. 750 (Cal. 2007) (codified at CAL HEALTH & SAFETY CODE, § 44270-74).
[277] CAL. CODE REGS. tit. 20, § 3101.5(b) (2013).
[278] CAL. CODE REGS. tit.. 12, § 3101.5(b)(2)(F) (2012); CAL. ENERGY COMM'N, 2011-2012 INVESTMENT PLAN FOR THE ALTERNATIVE AND RENEWABLE FUEL AND VEHICLE TECHNOLOGY PROGRAM 84 (2011), available at http://www.energy.ca.gov/2011publications/CEC-600-2011006/CEC-600-2011-006-CMF.pdf.
[279] CAL. CODE REGS. tit. 12, § 3101.5(b)(3).

considerations. The Timberland Productivity Act of 1982 designates commercial timberland zones within the State[280]219 to control uses of timberlands to ensure long-term productivity of California forest resources.[281]220 However, environmental considerations are part and parcel of "productivity" under the many environmental statutes that apply. California requires environmental review of state action through the California Environmental Quality Act (CEQA), similar to federal review under NEPA.[282]221 CEQA reaches private forest lands when the state finances the activities or when a government agency must approve it.[283]222 Under CEQA, if alternatives are available, the project sponsor must incorporate them into the project proposal to "[p]revent significant, avoidable damage to the environment." [284] A "significant" impact has or has the potential to cause substantial, adverse change in physical conditions of the proposed project area[285] and cumulative impacts.[286]

GHG emissions are assessed under CEQA[287] for "potential incremental contribution of GHGs" instead of an overall review of "the potential effect itself (i.e., climate change)."[288] Lead agencies must make a good-faith effort to calculate or estimate the amount of GHG emissions resulting from a project when determining significance.[289] The method, however, is left to the lead agency's discretion,[290] and the agency may determine that a project complies with an existing GHG regulatory program such as the LCFS.[291] Indeed, anyone conducting a CEQA analysis of GHG emissions would likely want to borrow from complex methodologies that have already been developed. If GHG emissions are cumulatively considerable, and thus require preparation of an environmental impact report (EIR), the agency must consider feasible GHG emission mitigation measures.[292]

As part of the environmental review of biodiversity effects, CNRA determines whether incremental contributions are cumulatively considerable in relation to whether the proposed project complies with previously approved habitat conservation plans (HCPs) or natural community conservation plans (NCCPs).[293]232 An EIR must still be prepared, however, if "there

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[280] California Timberland Productivity Act of 1982, CAL. GOV'T CODE § 51103 (West 2012).
[281] Id. § 51102.
[282] California Environmental Quality Act of 1970, CAL. PUB. RES. CODE § 21000–165 (2010); Katherine M. Baldwin, Note, NEPA and CEQA: Effective Legal Frameworks for Compelling Consideration of Adaptation to Climate Change, 82 S. CAL. L. REV. 769, 786 (2009) (including a general explanation of NEPA).
[283] CAL. CODE REGS. tit. 14, § 15002(b) (2013). "Governmental action" triggers the CEQA Guidelines, which is defined as "(1) [a]ctivities directly undertaken by a governmental agency, (2) [a]ctivities financed in whole or in part by a governmental agency, or (3) [p]rivate activities which require approval from a governmental agency." Id.
[284] . Id. § 15002(a)(3).
[285] CAL. CODE REGS. tit. 14, § 15382 (2013).
[286] "Cumulative impacts" is defined by the CEQA Guidelines as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." CAL. CODE REGS. tit. 14, § 15355 (2013). The CEQA Guidelines further explain that " [t]he individual effects may be changes resulting from a single project or a number of separate projects," and that "[c]umulative impacts can result from individually minor but collectively significant projects taking place over a period of time." Id.
[287] CAL. PUB. RES. CODE § 21083.05 (Supp. 2012); CAL. NATURAL RES. AGENCY, FINAL STATEMENT OF REASONS FOR REGULATORY ACTION, AMENDMENTS TO THE STATE CEQA GUIDELINES ADDRESSING ANALYSIS AND MITIGATION OF GREENHOUSE GAS EMISSIONS PURSUANT TO SB97 10 (2009), available at http://ceres.ca.gov/ceqa/docs/Final_Satement_of_Reasons.pdf [hereinafter CNRA FINAL STATEMENT]. See also Baldwin, supra note 221, at 793 (stating that legislation required OPR "to develop new CEQA Guidelines explaining how to evaluate GHGs in environmental impact assessments by July 1, 2009").
[288] CNRA FINAL STATEMENT, supra note 226, at 12.
[289] CAL. CODE REGS. tit. 14, § 15064.4(a) (2013).
[290] Id. § 15064.4(a)(1).
[291] Id. § 15064.4(b)(3).
[292] Id. §§ 15064.4(b)(3), 15126.4.
[293] See CAL. CODE REGS. tit. 14, § 15064.4(b)(3) (2013) (describing the need to conform to

is substantial evidence" that potential effects of a proposed project "are still cumulatively considerable" despite compliance with a previously approved plan.[294]233 If a lead agency determines that the proposed project's incremental contribution is not cumulatively considerable through reliance on a previously approved plan, the agency must explain implementing the plan will "ensure that the project's incremental contribution to the cumulative effect is not cumulatively considerable."[295]

Forestry projects go through a CEQA environmental checklist that includes the assessment of GHG emissions and efforts to reduce emissions.[296] A registered professional forester (RPF) prepares the checklist in order to determine whether the proposed project may potentially and significantly affect each natural resource concern on the checklist.[297]

Biodiversity Protection

Both the ESA[298] and the California Endangered Species Act (CESA)[299] apply to forestry operations. CESA prohibits taking, harming, or degrading of the habitats of plant and animal species that are classified as threatened or endangered without a permit.[300] When a private forestry project is likely to "take" a species federally or state listed as threatened or endangered, an incidental take permit (ITP) must be obtained for project approval.[301] The California Department of Fish and Game (CDFG) may approve an ITP only if review of the HCP reveals that, among other things, impacts will be fully mitigated and that funding for such mitigation and monitoring is available.[302]

California also maintains the Natural Community Conservation Planning Program (NCCPP), a broad ecosystem initiative designed to protect declining populations of plant and animal species while at the same time accommodating compatible land uses.[303] Similar to HCPs,[304] the NCCPP authorizes the CDFG to enter into incidental take agreements with private or public entities for proposed projects.[305] The program targets both listed and unlisted species.[306] A goal of NCCPP is to implement conservation measures that will prevent the future necessity of categorizing plant and animal species as threatened or endangered.[307] Agreements authorized by the NCCPP must be made pursuant to an NCCP.[308]

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other regulations and requirements regarding greenhouse gas emissions); CNRA FINAL STATEMENT, supra note 226, at 14–15.

[294] CAL. CODE REGS. tit. 14, § 15064.4(b)(3) (2013).

[295] Id. § 15064(h)(5).

[296] CAL. CODE REGS. tit. 14, § 932.9 (2013); CNRA FINAL STATEMENT, supra note 226, at 74–75.

[297] CAL. CODE REGS. tit. 14, § 932.9 (2013).

[298] Endangered Species Act of 1973, 16 USC. §§ 1531, 1536, 1539 (2006); Federal Habitat Conservation Planning, CAL. DEPT. OF FISH & WILDLIFE, http://www.dfg.ca.gov/habcon/conplan/fed_hcp/ (last visited Mar. 4, 2013).

[299] California Endangered Species Act of 1999, CAL. FISH & GAME CODE §§ 2050–2085 (West 2006).

[300] Id. § 2080–81.1.

[301] 16 USC. § 1539 (2006); US FISH & WILDLIFE SERV., HABITAT CONSERVATION PLANS, SECTION 10 OF THE ENDANGERED SPECIES ACT 1 (2002), available at http://library.fws.gov/Pubs9/hcp_section10.pdf [hereinafter US FISH & WILDLIFE SERV., HABITAT CONSERVATION PLANS].

[302] CAL. CODE REGS. tit. 14, § 783.4 (2013).

[303] Natural Community Conservation Planning (NCCP), CAL. DEP'T. OF FISH & GAME, http://www.dfg.ca.gov/habcon/nccp/ (last visited Jan. 24, 2013).

[304] CAL. NATIVE PLANT SOC'Y, CNPS MANUAL ON THE HCP-NCCP PROCESS 1, 5 (1999), available at http://www.cnps.org/cnps/archive/handbooks/hcp-nccp.pdf [hereinafter CAL. NATIVE PLANT SOC'Y].

[305] Natural Community Conservation Planning Act of 2003, CAL. FISH & GAME CODE § 2810 (West 2003).

[306] CAL. FISH & GAME CODE §§ 2801(i), 2805(e) (West 2003); CAL. NATIVE PLANT SOC'Y, supra note 243, at 1, 5.

[307] CAL. FISH & GAME CODE §§ 2801(i), 2805(e).

[308] Id. § 2810. Requirements of NCCPs include: (1) a definition of "the geographic scope of

Both HCPs and NCCPs have received extensive criticism since their inception.[309] The majority of criticism has centered on the "no surprises" policy[310] contained in both HCP and NCCP processes.[311] The "no surprises" policy assures HCP and NCCP participants that no additional mitigation measures or conservation practices, including financial compensation or and use restrictions, will be required for "unforeseen circumstances"[312] not addressed in the original HCP or NCCP.[313] Opponents of the "no surprises" policy argue that it significantly hinders agencies from appropriately responding to "future threats to protected species."[314]

Like many states, California has developed a Wildlife Action Plan as a condition for receipt of federal State Wildlife Grants Program monies. The Wildlife Action Plan is used to guide conservation decisions by identifying wildlife, stressors affecting them, and actions to ensure their future abundance.[315] California supports SFM, too, through programs like the Forest Stewardship Program and Forest Improvement Program, which provide technical assistance to private land owners and communities.[316] In exchange for financial assistance, the later program requires checklists for owners and RPFs to evaluate impacts of the proposed improvement[317] and a mini-management plan.[318] Biodiversity programs not specific to forestry

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the conservation planning area;" (2) a list of potential "natural communities, and the endangered, threatened, candidate, or other species known or reasonably expected to be found in those communities" that may be impacted; (3) identification of "preliminary conservation objectives for the planning area;" (4) description of "a process for the inclusion of independent scientific input," which will recommend (a) "scientifically sound conservation strategies for species and natural communities" included within the plan, (b) "a set of reserve design principles that addresses the needs of species, landscapes, ecosystems, and ecological processes in the planning area," (c) "management principles and conservation goals that can be used in developing a framework for the monitoring and adaptive management component of the plan," and will (d) "[i]dentify data gaps and uncertainties so that risk factors can be evaluated;" (5) compliance with ESA, including "coordination with federal wildlife agencies;" (6) encouragement of "concurrent planning for wetlands and waters of the [US];" (7) establishment of an interim review process for the project; and (8) establishment of a public participation process. Id.

[309] See Spirit of Sage Council v. Kempthorne, 51 F. Supp. 2d 31, 35, 36 (D.D.C. 2007) (challenging the validity of the federal "No Surprises Rule"); see also Envtl. Prot. Info. Ctr. v. Cal. Dep't of Forestry & Fire Prot., 187 P.3d 888, 920–21, 933 (Cal. 2008) (holding that the Incidental Take Permit was deficient to the extent it included a "no surprises" clause, which is determined by the HCP). See George F. Wilhere, Three Paradoxes of Habitat Conservation Plans, 44 ENVTL. MGMT. 1089, 1090 (2009) (listing literature that criticizes HCPs).

[310] DANIEL POLLAK, THE FUTURE OF HABITAT CONSERVATION? THE NCCP EXPERIENCE IN SOUTHERN CALIFORNIA 30 (2001), available at http://www.library.ca.gov/crb/01/09/01-009.pdf (explaining that criticism of HCPs and NCCPs "often focuses on the federal 'No Surprises' assurances").

[311] 50 C.F.R. §§ 17.22, 17.32 (2010); CAL. FISH & GAME CODE § 2820(f)(2).

[312] 50 C.F.R. § 17.3 (2010) (defining "[u]nforeseen circumstances" as "changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that could not reasonably have been anticipated by plan or agreement developers and the Service at the time of the conservation plan's or agreement's negotiation and development, and that result in a substantial and adverse change in the status of the covered species.").

[313] 50 C.F.R. §§ 17.22, 17.32; CAL. FISH & GAME CODE § 2820(f)(2). See also Wilhere, supra note 248, at 1090 (citing 50 C.F.R. § 17.22) (describing application of the "no surprises" policy to HCPs).

[314] POLLAK, supra note 249, at 30.

[315] CAL. DEP'T OF FISH & WILDLIFE, CALIFORNIA WILDLIFE: CONSERVATION CHALLENGES, CALIFORNIA'S WILDLIFE ACTION PLAN xi (2007), available at http://www.dfg.ca.gov/wildlife/WAP/docs/report/full-report.pdf.

[316] CA Forest Stewardship Program, STATE OF CAL., http://ceres.ca.gov/foreststeward/index.html (last visited Feb. 9, 2013); California Forest Improvement Program, CAL. DEP'T OF FORESTRY & FIRE PROT.,http://calfire.ca.gov/resource_mgt/resource_mgt_forestryassistance_cfip.php (last visited Feb. 9, 2013).

[317] CAL. DEP'T OF FORESTRY & FIRE PROT., CALIFORNIA FOREST IMPROVEMENT PROGRAM (CFIP) PROJECT REVIEW ENVIRONMENTAL CHECKLIST (2011), available at http://calfire.ca.gov/resource_mgt/downloads/CFIP/Locked_CFIP_Environmental_CheckList_110211.doc; CAL. DEP'T OF FORESTRY & FIRE PROT., 2011 CFIP RPF CHECKLIST (2011), available at http://calfire.ca.gov/resource_mgt/downloads/CFIP/Locked_2011_CFIP_RPF_CHECKLIST.doc.

[318] CAL. DEP'T OF FORESTRY & FIRE PROT., CFIP MINI MANAGEMENT PLAN FAS CHECKLIST, available at http://calfire.ca.gov/resource_mgt/downloads/CFIP/CFIP_MiniManagementPlan_CHECKLIST.doc.

include the Fisheries Restoration Grant Program,[319] California Essential Habitat Connectivity Project,[320] and Areas of Conservation Emphasis (ACE) program.[321]

The Forest Practices Act and Other Generic Environmental Laws

The Z'Berg–Nejedly Forest Practices Act (FPA) establishes standards governing private forest management activities in California.[322] The FPA charges the California Board of Forestry and Fire Protection (BoF), the authority responsible for implementing policies of the California Department of Forestry (CAL FIRE), with regulation of all timberlands to ensure sustainability and productivity.[323] The FPA requires BoF to divide the state into forest districts and develop and adopt Forest Practice Rules (FPRs) for each district.[324] The FPRs incorporate CEQA considerations,[325] as well as requirements of the Porter Cologne Water Quality Act (PCWQCA), the CESA, and all other environmental laws.[326] How these rules affect forestry requires an extensive analysis beyond the scope of this Article.[327] This abbreviated examination is not intended to gloss over criticisms that California forest and environmental rules have not stopped destructive practices.[328] Instead, it highlights the most significant structures to inform future debate over whether they adequately address the potential environmental ramifications of increased harvests of energy biomass from forests.

The TPA requires the California Department of Forestry (CDF) to manage forests for maximum sustained yield production (MSP).[329] Thus, the challenge with any increased energy biomass harvesting will be balancing the statutory charge to maximize yields with sustainability, just as with federal forests under the MUSYA. Any timber operation on private land triggers application of and compliance with FPRs,[330] including preparation and submission of a Timber Harvesting Plan (THP) by a RPF.[331] The THP must "[a]chieve a balance between growth and harvest over time" while "[m]aintain[ing] functional wildlife habitat in sufficient condition for

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[319] Fisheries Restoration Grant Program, CAL. DEP'T OF FISH AND WILDLIFE, http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/ (last visited Jan. 25, 2013).

[320] Connectivity, CAL. DEP'T OF FISH & WILDLIFE, http://www.dfg.ca.gov/habcon/connectivity/ (last visited Jan. 29, 2013).

[321] CAL. DEP'T OF FISH & WILDLIFE, AREAS OF CONSERVATION EMPHASIS (ACE-II): PROJECT REPORT 4, 6 (2010), available at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=24326&inline=1.

[322] Z'Berg-Nejedly Forest Practice Act of 1973 (codified as amended at CAL. PUB. RES. CODE § 4511–4628 (West 2001 & Supp. 2012)).

[323] Id. §§ 4513, 4516.5.

[324] Id. §§ 4531, 4551.

[325] SHARON E. DUGGAN & TARA MUELLER, GUIDE TO THE CALIFORNIA FOREST PRACTICE ACT AND RELATED LAWS 255 (2005). The THP serves as the functional equivalent of the CEQA EIR, although all other aspects of CEQA such as public review and mitigation apply. Id.

[326] CAL. CODE REGS. tit. 14, § 896 (2013).

[327] DUGGAN & MUELLER, supra note 264. The authors have written an entire book on the FPA, and thus those interested in more intricate details should look there. Id.

[328] See e.g., Thomas N. Lippe & Kathy Bailey, Regulation of Logging on Private Land in California Under Governor Gray Davis, 31 GOLDEN GATE U. L. R. 351, 353–55 (2001) ("[A]ll of the independent programmatic reviews of the state's regulation of logging have found that California is not achieving its professed goal of protecting the environment.").

[329] CAL. PUB. RES. CODE § 4513(b).

[330] Id. §§ 4527, 4551.5 (defining "[t]imber operations" as "the cutting or removal, or both, of timber or other solid wood forest products, including Christmas trees, from timberlands for commercial purposes, together with all the incidental work, including, but not limited to, construction and maintenance of roads, fuelbreaks, firebreaks, stream crossings, landings, skid trails, and beds for the falling of trees, fire hazard abatement, and site preparation that involves disturbance of soil or burning of vegetation following timber harvesting activities, but excluding preparatory work such as treemarking, surveying, or roadflagging.").

[331] Id. § 4581. For a list of current THPs submitted for public comments, see California 2012 Timber Harvest Plan (THP) Database, THP TRACKING CENTER, http://www.thptrackingcenter.org/database/thpca2012.html (last visited Mar. 1, 2013).

continued use... within the planning watershed."[332] This includes retaining older and diverse sets of habitat to provide connectivity[333] and identifying watercourses within the area of the proposed timber operation.[334]

These requirements to protect wildlife and habitat, therefore, at least on paper would prevent an argument that they may be considered only in relation to silvicultural support of productivity. Harvest applicants may demonstrate achievement of MSP in three ways, including alternatives to THPs for smaller or non-industrial owners;[335] each must consider, however, environmental impacts.[336] The FPA requires the Director of the BoF to review THPs to ensure compliance with the FPA and FPRs,[337] with the ultimate goal of maintaining healthy and naturally diverse forests.[338] FPRs charge the BoF Director with responsibility for reviewing THPs on a large scale, cumulative basis to ensure maintenance of higher scale biological diversity and watershed integrity.[339] In this review of THPs, the Director applies the following guiding principles:

- Achieve a balance between growth and harvest over time consistent with the harvesting methods within the rules of the Board.
- Maintain functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within the planning watershed.
- Retain or recruit late and diverse seral stage habitat components for wildlife concentrated in the watercourse and lake zones and as appropriate to provide for functional connectivity between habitats.[340]
- Maintain growing stock, genetic diversity, and soil productivity.[341]

Thus, at least on paper, BoF should consider landscape impacts from increased biomass harvests if they occur. The public, too, is entitled to review THPs,[342] although the CDF "almost always approves" them.[343] Any person seeking to convert three contiguous acres or more to a non-timber use (e.g., agriculture) must apply for a Timber Conversion Permit.[344] Conversion to agricultural energy biomass, such as short rotation woody crops, has been a great concern of environmental groups.

FPRs require maintenance, protection, and restoration of affected beneficial uses of water, and beneficial functions of riparian zones, during and after timber operations.[345] PCWQCA gives the State Water Resources Control Board the authority to implement state water rights and water quality policies.[346] PCWQCA divides California into nine Regional Water Quality

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[332] CAL. CODE REGS. tit. 14, § 897(b)(1)(A)–(B); DUGGAN & MUELLER, supra note 264, at 158.
[333] CAL. CODE REGS. tit. 14, § 897(b)(1)(C).
[334] Id. § 1034.
[335] DUGGAN & MUELLER, supra note 264, at 160–64.
[336] Id. at 161–64. For a more detailed analysis of standards for the protection of animals and plants, see Chapter 5. Id. at 253–317.
[337] CAL. CODE REGS. tit. 14, § 897.
[338] Id.
[339] Id.
[340] The US Fish & Wildlife Service defines "seral stage" as "[a]ny plant community whose plant composition is changing in a predicable way," which is "characterized by a group of species or plant community that will eventually be replaced by a different group of species or plant community." US FISH & WILDLIFE SERV., APPENDIX FOR THE FINAL COMPREHENSIVE CONSERVATION PLAN AND ENVIRONMENTAL IMPACT STATEMENT FOR THE LITTLE PEND OREILLE NATIONAL WILDLIFE REFUGE , A-11 (2000), available at http://www.fws.gov/pacific/planning/LPOccp/v2.pdf. "Late seral stage forest" is defined as "[a] forest in the mature stage of development, usually dominated by large, old trees." Id. at A-6.
[341] Id.
[342] CAL. PUB. RES. CODE § 4582.7.
[343] DUGGAN & MUELLER, supra note 264, at 129.
[344] CAL. PUB. RES. CODE § 4621.
[345] Id. §§ 4514.3, 4562.7.
[346] Porter-Cologne Water Quality Control Act of 1969, CAL. WATER CODE §§ 13000–14076 (West 2012).

Control Boards, which must develop Basin Plans.[347] The Basin Plans designate beneficial uses of water, water quality standards, and necessary actions to maintain those standards,[348] including regulation of point and non-point sources of pollution to state surface water and groundwater resources through issuance of pollution discharge permits.[349] The Director must disapprove THPs that would otherwise violate water quality control plans created by the State Water Resources Control Board.[350]

Hazard Prevention

CNRA has expressed concerns about the effects of climate change on forest fires.[351] Warmer climates generally lead to longer summers and to dried vegetation that fuels and hastens fire ignition and spread.[352] CNRA has concluded that this changed weather cycle is "expected to increase the number and intensity of forest fires."[353] The California Office of Environmental Health Hazard Assessment (OEHHA) also has determined that long-term fire management strategies and land uses that are intended to suppress surface fires generally change the structure and density of vegetative biomass, which can increase the likelihood of forest fires[354] that release copious amounts of carbon into the atmosphere.

One of the greatest sources of angst regarding the sustainability of forest-to-energy biomass originates in hazard-reduction exemptions often contained in forestry regulations. In California, operators are exempt from preparing a THP[355] when harvesting "dead, dying or diseased trees"; "fuelwood or split products"; and "trees which are unmerchantable as sawlog-size timber from substantially damaged timberlands;" and when removing or cutting of trees that reduce flammable materials, such as vegetative fuels and tree crowns, to create fuelbreaks.[356] Persons conducting timber operations that fall within an exemption category must still submit, however, "a notice of proposed timber operations" on a form provided by CAL FIRE before commencing timber operations.[357] Exemptions are presumed to impose no significant adverse environmental effects and are not subject to the BoF review standards imposed on THPs. Proposals are automatically approved within a specified time period if the Director fails to act on the proposal.[358] As with the litigation that eventually enjoined the categorical exemptions contained in the federal Healthy Forests Restoration Act, lack of review for exemptions creates fears that the forest industry will exploit exemption standards to avoid more stringent and time consuming THP standards.[359]

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[347] Id. §§ 13200, 13240.
[348] Id. § 13241.
[349] Id. § 13260.
[350] CAL. CODE REGS. tit. 14, § 898.2h (2013); CAL. CODE REGS. tit. 23, § 3 (2013).
[351] CNRA FINAL STATEMENT, supra note 226, at 7.
[352] Id. (citing A.L. WESTERLING ET AL., CLIMATE CHANGE CTR., CLIMATE CHANGE, GROWTH, AND CALIFORNIA WILDFIRE 10 (2009), available at http://www.energy.ca.gov/2009publications/CEC500-2009-046/CEC-500-2009-046-D.PDF).
[353] Id. (citing OFFICE OF ENVTL. HEALTH HAZARD ASSESSMENT, INDICATORS OF CLIMATE CHANGE IN CALIFORNIA 131 (2009), available at http://oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsApril2009.pdf [hereinafter OEHHA]).
[354] OEHHA, supra note 292, at 134.
[355] CAL. CODE REGS. tit. 14, § 1038 (2013).
[356] Id.
[357] Id. § 1038.2.
[358] Id. § 1038. See also CHRISTOPHER A. DICUS & KENNETH DELFINO, A COMPARISON OF CALIFORNIA FOREST PRACTICE RULES AND TWO FOREST CERTIFICATION SYSTEMS, 44 (2003) available at http://sotsnf.org/pdf/Cal_Poly-Forest_Practices-2003.pdf ("[E]xemptions are 'ministerial' (automatically approved without discretion) and are presumed to have a minimal adverse effect on the environment.").
[359] DICUS & DELFINO, supra note 297, at 44.

Recognizing possible loopholes in the exemption standards, the BoF has imposed limitations and penalties on timber operations subject to exemptions.[360] For example, the BoF has clearly indicated that all exempt timber operations must still comply with provisions of the FPA and FPRs that would be applicable to THPs,[361] including rules and regulations governing timber harvesting requirements and environmental protection measures.[362] All timber operation exemptions are limited to one year.[363] In addition, the harvest of dead, dying, or diseased trees and fuel wood or split products is limited to "less than [ten] percent of the average volume per acre" within the geographic area of the timber operations.[364]303 Removing or cutting trees to reduce flammable materials and create a fuel break is limited only to trees within 150 feet of an "approved and legally permitted structure."[365]

Conscious of the severity and likelihood of operators exploiting FPR procedures, the California legislature passed SB 621 in 1999 to impose harsher penalties on violators of the FPRs.[366] Conscious violators of the FPRs can incur a civil penalty of up to $10,000 per violation.[367] While biomass harvesting for bioenergy can lend support to fire prevention measures, the practice runs the risk of being merely a pretext to avoid preparation of a THP. The limited scope of exempt timber operations and the stiff penalties imposed on violators of the FPRs, however, may significantly reduce the likelihood of overharvest.

Massachusetts

While California contemplates bioenergy-specific standards for forest biomass, the Massachusetts Department of Energy Resources (DOER) issued rules in 2012 specifically addressing the sustainability of forest biomass feedstocks qualifying for the state's RPS.[368]The rules are based in part on the much-publicized Manomet Study—the first national study to assess the possible impacts on forests and GHG emissions from the transition from traditional fossil fuels to bioenergy.[369] The study analyzed three core questions: (1) the GHG implications of forest biomass substitution, (2) the amount of available forest biomass necessary to support the state's energy goals, and (3) the potential ecological impacts of increased biomass harvests in state forests and the policies necessary to ensure the continued sustainability of the harvests.[370]309 With regard to the latter, the study examines sustainability rules in various states and recommends generally how to structure standards.[371] Generally, the report recognizes the need for additional standards because of "general public anxiety over environmental protection," "the obligation to correct misapplied forestry practices," "the need for greater accountability," "growth of local ordinances," "landscape-level concerns," and "following the lead of others."[372]

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[360] CAL. CODE REGS. tit. 14, §§ 1038, 1038.1, 1038.2.
[361] Id. § 1038.1.
[362] HEATHER MORRISON, YANA VALACHOVIC & CLARALYNN NUNAMAKER, LAWS AND REGULATIONS AFFECTING FORESTS, PART I: TIMBER HARVESTING 7 (2007), available at http://anrcatalog.ucdavis.edu/pdf/8249.pdf.
[363] CAL. CODE REGS. tit. 14, § 1038.1.
[364] Id.
[365] Id. An "approved and legally permitted structure" must comply with the California Building Code. Id.
[366] S.B. 621 (1999) (codified at CAL. PUB. RES. CODE §§ 4612, 4554.5, 4601.1, 4601.1, 4601.2, 4601.3, 4601.4, 4601.5 (2000)). See also DICUS & DELFINO, supra note 297, at 51 (explaining that, prior to 2000, "there was little enforcement available" for violators of the FPRs but, after enactment of SB 621 in January 2000, "much stiffer penalties for conscious violators of the FPRs" were available).
[367] CAL. PUB. RES. CODE § 4601.1 (Supp. 2012).
[368] 225 MASS CODE REG. §§ 14.01–14.13 (2010).
[369] MANOMET CTR. FOR CONSERVATION SCI., BIOMASS SUSTAINABILITY AND CARBON POLICY STUDY 6 (Jun. 2010), available at http://www.manomet.org/sites/manomet.org/files/Manomet_Biomass_Report_Full_LoRez.pdf
[370] Id.
[371] Id. at app. 150–57.
[372] Id. at app. 151.

Massachusetts's new rules define sources of "eligible woody biomass," which, as seen in North Carolina's implementation of its RPS,[373] can be controversial. Massachusetts includes residues,[374] thinnings,[375] forest salvage,[376] and non-forest derived residues including trees removed for non-agricultural and agricultural land use change.[377] Additional restrictions are enumerated in a set of spreadsheet guidelines for "biomass fuel certificates" required from regulated parties to prove compliance with the RPS rules.[378] The certificate must detail that residues have been derived from harvest by-products or from damage caused by invasive species to prevent prohibited material or materials in prohibited amounts from entering the supply chain.[379] Excluded material includes biomass from old growth forests stands, naturally down woody material, forest litter, forest floor roots and stumps, live cavity trees, den trees, and live but decaying trees and snags.[380]319 In addition, the amounts of biomass eligible to be taken away from a harvest site are tied to the overall tonnage of biomass harvested and to the quality of the soil and slope at the harvest site.[381]

The regulation places great emphasis on soil structure and function. For areas deemed to be of poor soil quality, one-hundred percent of the tops and branches from the forest material must remain on site in order to prevent erosion and to supplement soil conditions and quality.[382] In cases where soil quality is "good," twenty-five percent of the tops and branches from the harvest must remain on site.[383] In all cases, thirty percent of material eligible for thinning must remain.[384] A soil designation of "good" or "poor" is determined by set criteria established by DOER and the US Department of Agriculture Natural Resource Conservation Service.[385]

From a carbon perspective, the regulation requires that the generation unit demonstrates a fifty percent reduction of lifecycle GHG emissions, over a twenty-year life cycle, compared to a new natural gas generating facility.[386] In addition, each year the unit must document total tonnage through its biomass fuel certificates.[387]The certificate is also used to verify the source of forest-derived residues and thinnings through either a Massachusetts Department of

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[373] The lack of a definition of "biomass" led to litigation to resolve whether whole trees can be combusted for electricity generation and still count toward North Carolina's RPS. See North Carolina v. Envtl. Def. Fund, 716 S.E.2d 370, 371, 372 (N.C. Ct. App. 2011). For a general discussion of the debate about how to define qualifying sources, see Inge Stupak et al., Criteria and Indicators for Sustainable Forest Fuel Production and Harvesting: A Review of Current Standards for Sustainable Forest Management, 35 BIOMASS & BIOENERGY 3287, 3291 (2011) (noting that because woodfuels are collected from a wide variety of sources, some confusion has arisen over the very definition of a forest).

[374] The regulation defines residues as "[t]ops, crooks and other portions of trees produced as a byproduct during the normal course of harvesting material . . . . other woody vegetation that interferes with regeneration or the natural growth of the forest, limited to locally invasive woody vegetation." 225 MASS. CODE REGS. § 14.02.

[375] The regulation defines thinnings as including whole trees that are "weak or have low vigor" and "[t]rees removed during thinning operations, the purpose of which is to reduce stand density and enhance diameter growth and volume of the residual stand." Id.

[376] The regulation defines salvage as "[d]amaged, dying or dead trees" due to weather events or disease, and trees removed to reduce fire hazard, but not those trees removed due to competition. Id.

[377] Id.

[378] MASS. DEP'T OF ENERGY RES. FOREST DERIVED ELIGIBLE BIOMASS WOODY FUEL GUIDELINE (2012), available at http://www.mass.gov/eea/docs/doer/renewables/biomass/ma-rpsregulation-biomass-eligibility-and-certificate-guideline-doer-112012.xlsx

[379] Id. at tab "Biomass Restrictions."

[380] Id.

[381] Id.

[382] Id.

[383] Id.

[384] Id.

[385] Id.

[386] 225 CODE OF MASS. REG. § 14.02, 14.05(1)(a)(7).

[387] Id. § 14.05(8).

Conservation and Recreation (DCR) "cutting plan" or other equivalent state plan prepared by a licensed forester, or by obtaining the signature of a professional forester.[388]327

Beyond regulation and guidance specific to the RPS, any forest harvesting activity in the state above a certain volume must be conducted in accord with the approved cutting plan pursuant to the Forest Cutting Practices Act (FCPA),[389] including compliance with the Best Management Practices Manual.[390] Like BMPs in other states, Massachusetts's BMPs address through requirements and voluntary guidance aspects of sustainability such as: planning, access roads and trails, landings, measures to combat sedimentation runoff, stream crossings, wetlands, vernal pools, rare and endangered species, chemical management, prescribed burning and wildfire, site closure, and compliance with Massachusetts's "slash"[391] laws to address aesthetics, fire hazard, and water quality.[392] Like California, Massachusetts maintains its own Endangered Species Act[393] that the BMP manual explains with regard to the cutting plan and review by the state forester of protection of species on the state's Natural Heritage Atlas.[394]

3.3. Russia

3.3.1. Introduction to the Northwest Russian Case Study

A key region for forest biomass supply is Northwest Russia, an area that include Karelia, Komi, Arkhangelsk, Vologda, Leningrad, Novgorod and Pskov where several wood pellet plants have been built over the last years (see Figure 1).

About 30-50 % of the total Russian wood production comes from this region (Krismann 2012). 95% of Russia's Northwest forests are located in the boreal zone, and 70% of them are coniferous forests (12.5% spruce and fir, 16% pine; 6% Siberian and Korean cedar pine). About 17% are secondary forests mainly planted with birch and aspen (Shvidenko et al. 2007).

Northwest Russia is a pioneer region for the entire Russian forest sector; the proximity to European markets pushed export efforts, especially to Baltic Sea neighbors.

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[388] Id. § 14.05(8)(a)(3)a.
[389] MASS. GEN. LAWS, ch. 132, §§ 42, 44 (1990).
[390] DAVID B. KITTREDGE, JR. & MICHAEL PARKER, MASSACHUSETTS FORESTRY BEST MANAGEMENT PRACTICES MANUAL 1 (3d prtg. Jan. 2000), available at http://masswoods.net/images/stories/pdf/BMP_Manual.pdf
[391] Slash includes the "residue, e.g., treetops and branches, left on the ground after logging." The Dictionary of Forestry, SOCIETY OF AM. FORESTERS, http://dictionaryofforestry.org/dict/term/slash (last visited Jan. 31, 2013).
[392] KITTREDGE & PARKER, supra note 329.
[393] MASS. GEN LAWS, ch. 131A (1990); 321 MASS. CODE REGS. 10.00 (2010).
[394] MASS. GEN. LAWS, ch. 131A § 44.

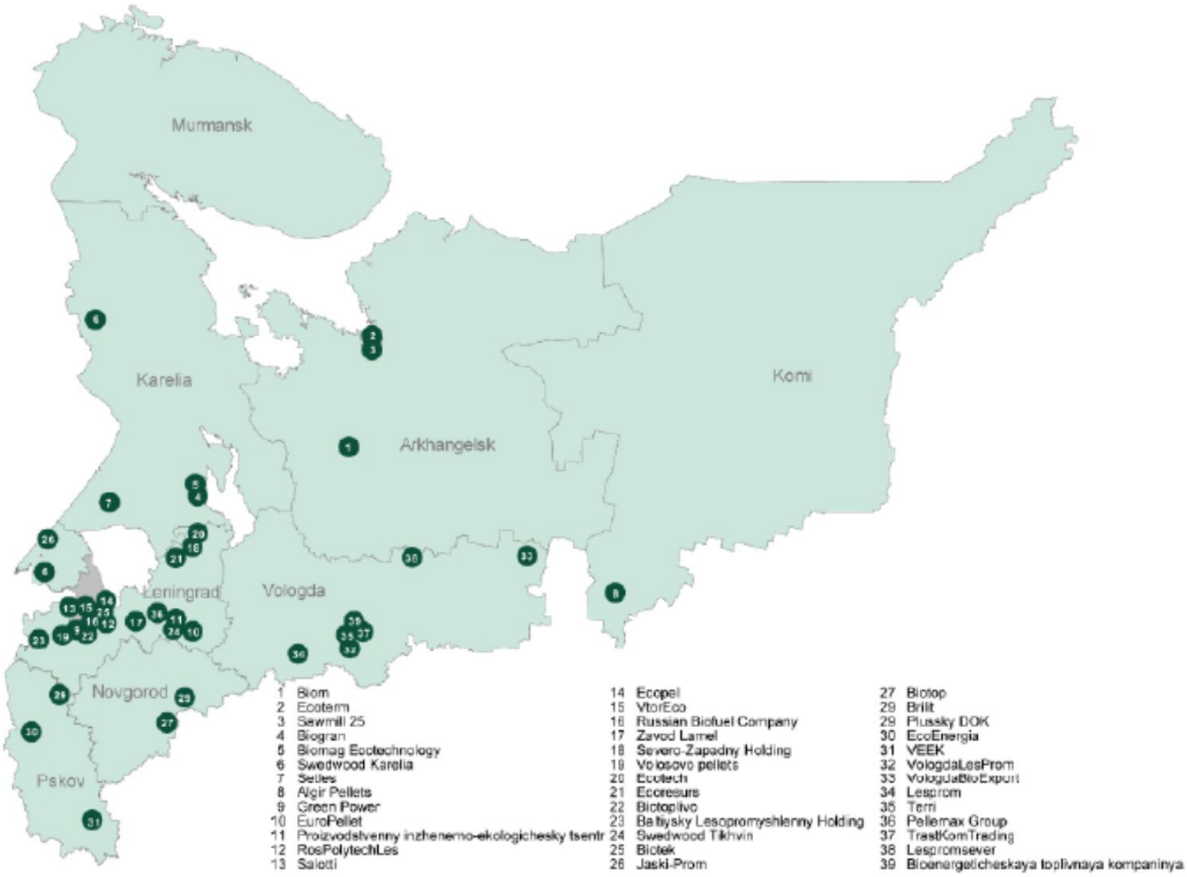

Figure 1. Northwest Russia and Sites of Major Pellet Plants
Source: www.woodpellets.com

3.3.2. Key characteristics of the woody bioenergy sector in Northwestern Russia

Energy Use of Forests and Development of the Pellet Industry

Russian pellet production has developed rapidly in recent years; it has experienced a boom from 2009-2011 when private investors mainly from Scandinavia and Germany together with the Russian private sector built new pellet plants. The statistics of the last five years shows a clear upward trend in terms of volume. In 2010, the largest Russian pellet plant with a production capacity of 1 Mt/a opened in Sovietsky, northwest of St. Petersburg on the shore of the Baltic Sea. One of the largest pellet plants in Vyborg exported 0.5 Mt of pellets to Europe in 2012; its capacity reached about 1 Mt per year in 2013.

In 2012, Russia produced more than 1.3 Mt of pellets, an increase of 16% compared to 2010. However, compared to other forestry products, pellets are still rather insignificant (in the low single-digit percentage range).

Up to 2006, wood for the pellet industry in Russia came almost exclusively from sawdust and industrial wood waste (Shablovsky 2007); forest residues were hardly used as logistical costs were too high. However, since 2007, more and more pellet plants directly lease forests and process whole trees into pellets (Krismann 2012; Rilling 2012; Rilling, Krismann 2013). The leased lands that provide the trees are typically located in the vicinity (i.e. within a 200 km radius) of the pellet plant.

After 2006, a second wave of pellet development occurred which focused on Central Russia and was intended to cover internal consumption, especially in Moscow. However, the domestic consumption share stayed below 30% of total Russian pellet production due to a lack

of private or municipal pellet heating systems. Still, the goal of the Russian government is to increase wood processing and utilization in the country and the domestic use of pellets: the objective is to increase the share of renewable energy in Russia from 1% to 4.5% by 2020 (RU 2011).

Various data indicate that most of the wood used for pellet production has been certified and therefore originates from sustainable sources (Krismann 2012). Lease agreements for forests in Russia are now made for a period of 49 years, which make reforestation and other forest stewardship activities pay off economically.

Figure 2. Charge for the world's largest pellet factory in Sovietsky in the Baltic Sea
Source: www.vybcell.ru; The load is 1400 t of Aspen (stem wood) from Northwestern Russia (photo April 2010)

According to the estimates of experts, further growth of the pellets is forecasted, although the annual increase has slowed. According to market analyses for pellets, current exports of Russian pellets supply about 16% of the European pellet market (Rilling, Krismann 2013).

If the current trend of pellet exports to the EU continues, it would reach some 2 Mt per year by 2015. According to optimistic estimates, the volume of exports of pellets from Russia to the EU could rise to 5 to 6 Mt per year by 2020 (Rilling, Krismann 2013). According to the National Forestry Development Agency, a 15-20% increase of pellet production in Russia is expected in the next few years, especially for exports to Denmark and Sweden.

Despite the steady increase in the entire pellet production and exports, the number of pellet plants has declined over the last two years, as mainly small and medium-sized enterprises lost market shares. According to experts, the strength of small and medium-sized enterprises

would rather be in the domestic market, where pellets can be sold more cost-effectively through contracts with local heating plant operators (Rakitova 2013).

The monopolization of Russian pellets production will continue with an increase of overall production from enterprises which specialize exclusively on pellets for export markets (Sodko 2013).

Influence of Prices on the Development of the Pellet Industry

As shown in Table $$ the FOB ST Petersburg prices have increased from 85-90 €/t in 2003 up to 105-120 €/t in 2009, with domestic prices approx. 30% higher. (For comparison, the retail price in Germany rose from 220 €/t in 2009 to almost 250 €/t in 2012.) Since 2009, export investments in Russia grew further due to a sharp devaluation of the Ruble (40% compared to the Euro).

Table 16. The dynamics of bulk industrial pellet prices FOB and CPT Seaport St. Petersburg

	2003	2004	2005	2006	2007	2008 (September)	March (2009)
FOB ST Petersburg	85-90	90-95	95-105	110-125	90-100	95-105	105-120
CPT St. Petersburg	70-80	75-80	75-90	80-105	75-85	85-95	95-115

Source: Rakitova, Ovsyanko (2009); data are in €/t

Note: CPT Carriage Paid To -- Title, risk and insurance cost pass to buyer when delivered to carrier by seller who pays transportation cost to destination. Used for any mode of transportation.

FOB Free On Board -- Title and risk pass to buyer including payment of all transportation and insurance cost once delivered on board the ship by the seller. Used for sea or inland waterway transportation.

Transport Routes in the EU

Half of all pellet exports reach Western Europe via the ports of Petersburg and Ust-Luga. Rail transport and especially truck transports are not documented well, but appear substantial, especially in the direction of southern Germany, Switzerland and Austria.

3.3.3. Impact of forest biomass utilization on biodiversity, soil and water

The bigger pellet plants lease forest lands to harvest whole trees as feedstock for pellet production. This pressure on Russian forests, although negligible for the moment, is clearly increasing. However, procurement of forest biomass for pellet production and export occur almost completely in forests under environmental certification. Therefore, forests procuring feedstock for pellets are likely more sustainably managed than other forest areas under ordinary, non-certified forest management.

Natural forests with high biodiversity located in Northwest Russia were identified using the methodology of Andersson et al. (2009).

In Northwest Russia, 32% of available timber volume was left in the forests in 2010 (Bemmann 2012; GTAI 2010). If this wood potential could be mobilized for pellet production in Russia, the clearcutting areas would significantly be reduced. However, increased extraction of biomass from a given sites could have negative consequences for biodiversity and soil fertility.

On the other hand, the increased utilization of sawdust for pellet production reduces the problem of sawdust waste which is partly disposed on forest edges with negative consequences for biodiversity.

According to expert opinion, current regulations for soil and water conservation are not sufficiently implemented in Russia (Krismann 2012). Illegal logging is also likely to be rampant. Moreover, it is likely that areas that can be considered primary forests (approximately 10-15%

of North-Western Russia) are affected by pellet sourcing. The existing reserve system in Russia (which covers about 6% of the forest area) is not suitable for the protection of primary forests.

The Russian forest law was amended in 2007, bringing administrative reform with new responsibilities which aims to improve the development and commercialization of forests. One example of reform is the shift away from 5-year leases toward 10-49 year lease agreements.

Russian forests are almost exclusively State-owned (FAO 2012). They can be categorized in three types:

1. Operational forests (as defined in FAO 2010): they offer free access for private investors with lease contracts. The harvesting is exclusively performed by clearcutting; partial harvesting usually takes place only in connection with sanitary logging. After clearcutting, regeneration is generally ensured by replanting; however, in Eastern and Northern regions of Russia, sites are often regenerated naturally. At the State level, "ecological" forest management is now being promoted; clear-cutting is currently performed on 90% of harvested areas, but the objective is to reduce this proportion to 30% (Krismann 2012).
2. Protection forests: low impact logging is allowed, but no clear-cutting.
3. Reserve forests: no harvesting is planned/allowed for the next 20 years. These areas include many primary forests.

According to the FRA for the Russian Federation (FAO 2010), the total forest area is 809 Mha of which 416 Mha are operational forests, 181 Mha protective forests and 213 Mha reserve forests (i.e. remote forests which will not be developed in 20 or more years). The protective forests distinguish:

- Protection of soil and water: 71.4 Mha
- Conservation of biodiversity: 17.6 Mha
- Social Services: 12.9 Mha
- Multiple uses: 78.7 Mha

More specifically, Forest Europe (2011) reports the following area of protected forests in 2010:

- No active intervention: 12.3 Mha
- Minimum intervention: 4.4 Mha
- Conservation through active management: 0.03 Mha
- Landscape protection: 0.09 Mha

Maps are available online with detailed documentation (See http://oopt.info/; in Russian). The national parks are under the central supervision of the Federal Agency for Nature. The best data source for Northwest Russia is provided by the NGO "Transparent World" including red list species as well as all categories of protected area in a GIS (see http://gis.transparentworld.ru/en/gapnw/). The vegetation zones and units and reserve categories are shown in the following figures.

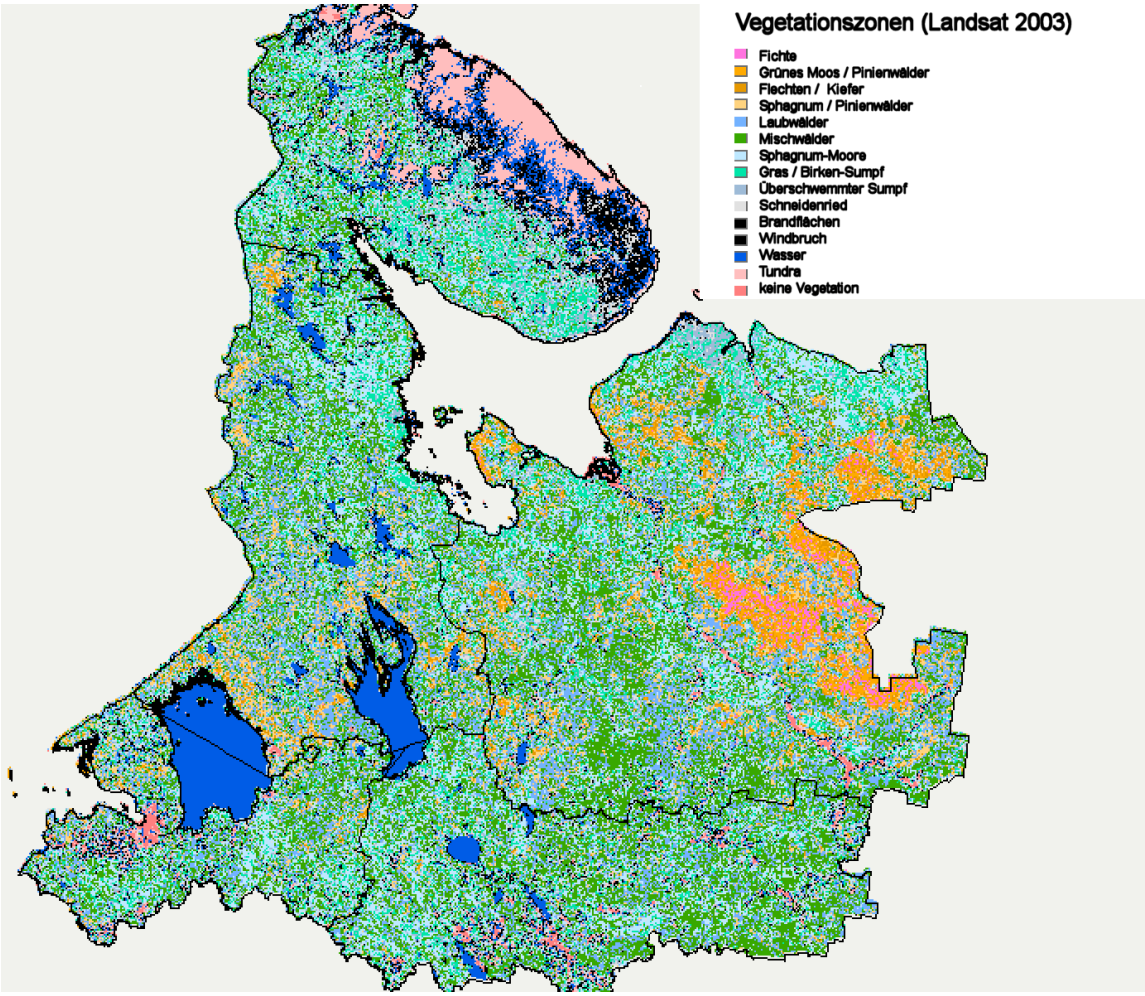

Figure 3. Vegetation Units in Northwest Russia
Source: http://gis.transparentworld.ru/en/gapnw

High biodiversity areas also include the extensive hardwood forests (valuable managed hardwood forest, with low or very low impact activities). These forests cover a greater area than primary forests. Data on location and extent of these ecosystems may be published only with the consent of the local tenants.

The increasing fragmentation of primary forests is mainly brought by the construction of roads by Western investors. Fragmented forests are defined as forests that have unseparated surfaces of less than 100 km².

Andersson et al. (2009) distinguishes three types of forests with high biodiversity: primary forests, forests with high conservation and old-growth forests. The mapping manual developed by Andersson et al. (2009) for Northwest Russia is largely applied. The main reason for this is the demand of foreign investors who want to lease almost exclusively certified forests.

However, the Russian Government considers this data acquisition and mapping to be too detailed (in terms of the geographic location) and does not recognize it. On the other hand, comprehensive forest inventory data exist within local forestry authorities, which identify biologically valuable forests and primary forests. A forest inventory for Russia is carried out every 5 years (FAO 2010).

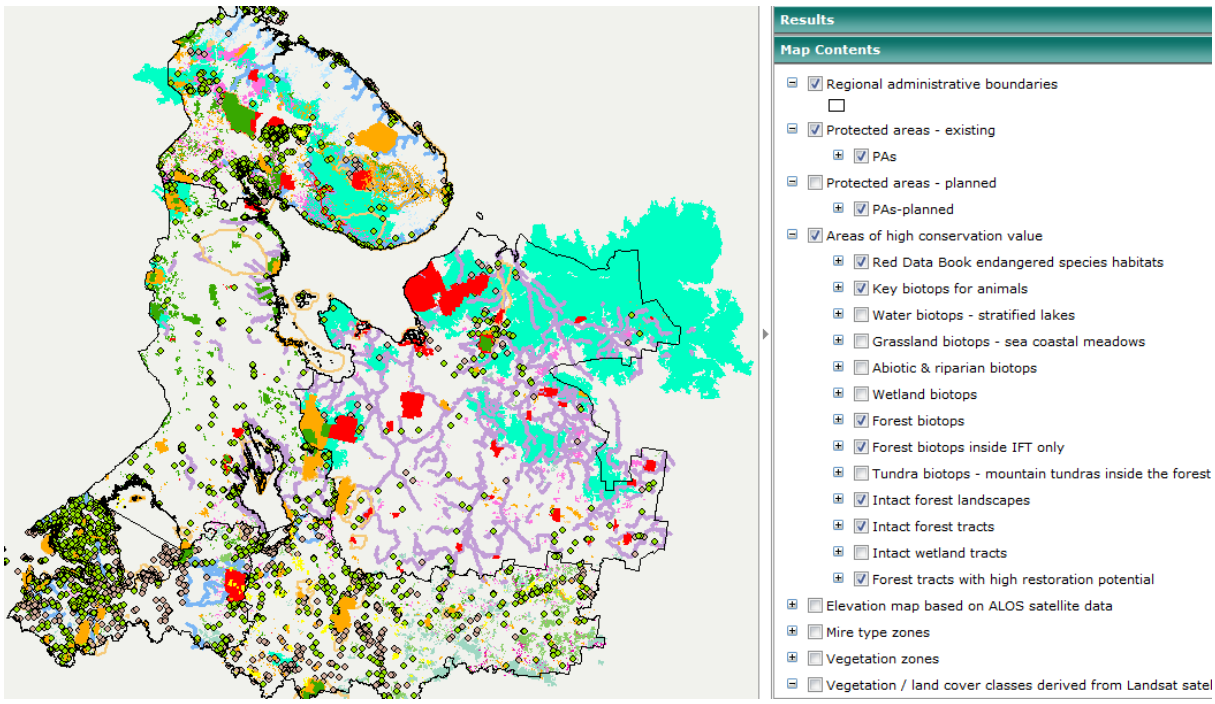

Figure 4. Protected Areas and Occurrence of Red List Species in Northwest Russia.
Source: http://gis.transparentworld.ru/en/gapnw

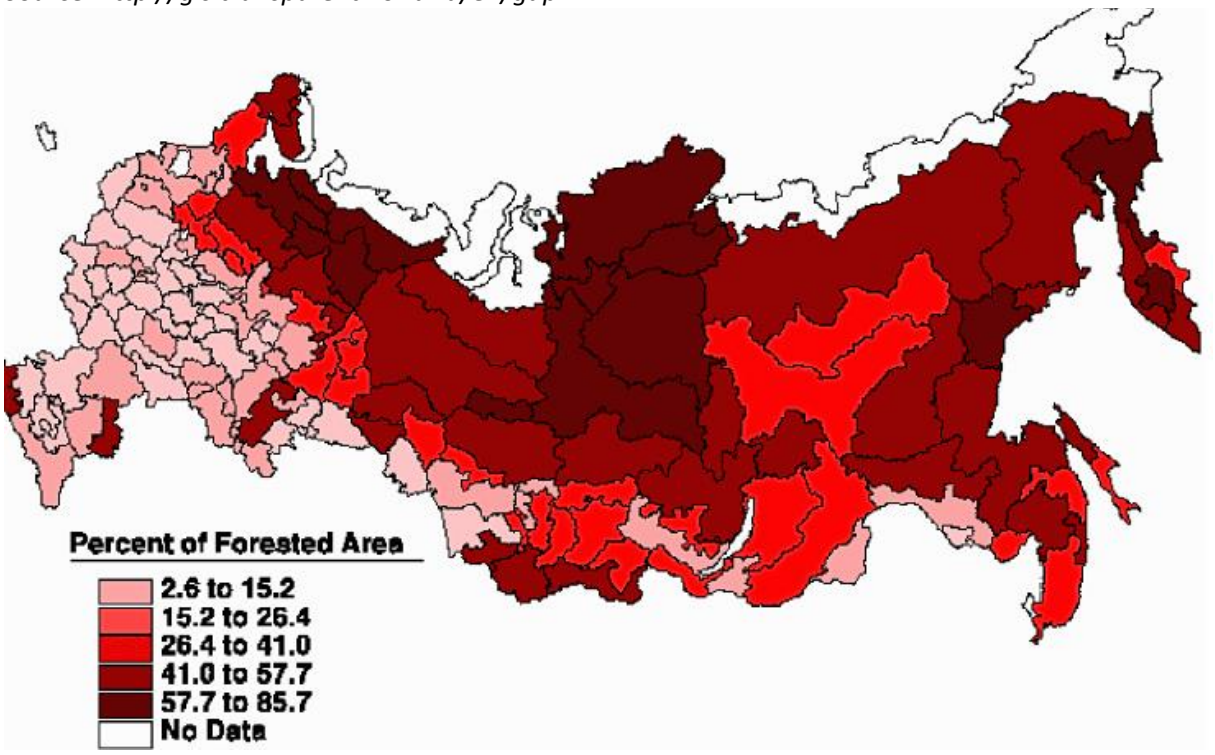

Figure 5. Distribution and Percentages of Protected Forests in Russia.
Source: Nilsson, Shvidenko (1998)

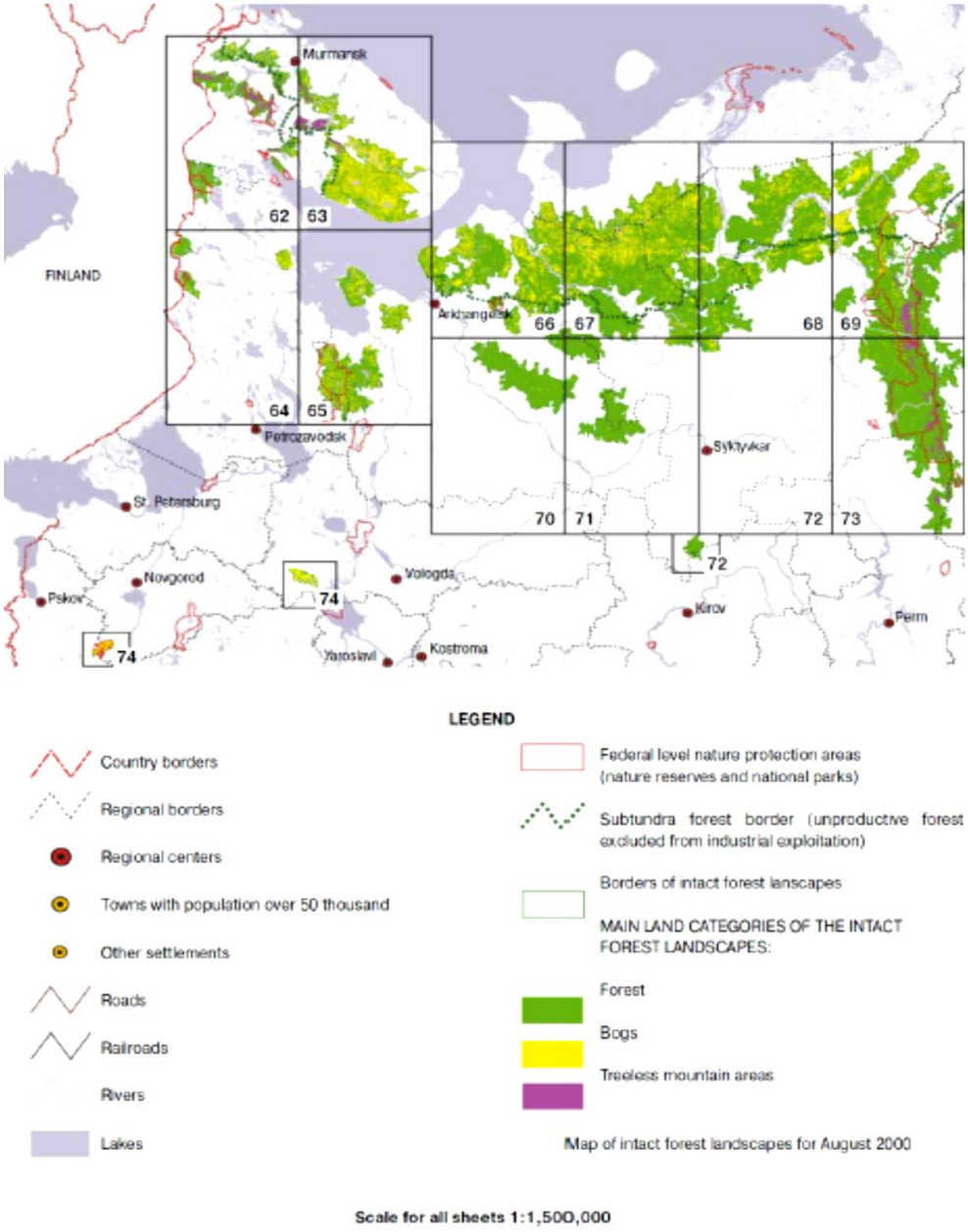

Figure 6. Primary Forests in Russia in the Year 2000.
Source: Yaroshenko et al. (2001)

3.3.4. Voluntary Sustainable Forestry Standards in Russia

Currently, all foreign operators in forests of Northwest Russia are FSC or PEFC certified. However, the certification is generally weak, as the case of IKEA in Karelia shows (see Figure 7). Retention stands appear to represent less than the required 35% of the total harvested areas. As a rule, harvested areas are left to regenerate naturally to promote biodiversity and also for reasons of efficiency. In some cases, the application of FSC standards resulted in conflicts with Russian forest legislation and practices (Nysten Haarala 2011, Matilainen 2011).

Figure 7. Clearcutting of Karelia Forests with FSC certification for IKEA
Source: www.protecttheforest.se

Current government policies aim at a target of 400 Mha of certified forests by 2020 (FSC Russia 2012; Tulaeva 2012; Elbakidze et al. 2011). According to FSC Russia, 6.4 Mha of forest area were certified in Russia at the end of September 2005 (WWF 2005). By the end of 2010, about 24 Mha were FSC certified, and the total area of FSC certified forests has risen to 30.5 Mha in the three months of the year 2011. As a result, Russia takes second place in the world after Canada. It is expected that the certification of forests will grow, because the European Union, the United States and China have set stricter environmental requirements for purchased wood in accordance with their laws, such as the EU Timber Regulation (EU 2010a).

In Northwestern of Russia, deforestation is particularly active in the Arkhangelsk and Vologda regions, as well as in Karelia. This situation is exacerbated by the proximity to Sweden, Finland and Denmark, as well as by the well-developed road network and the high price of wood (EGINFORUM 2012).

3.3.5. Forest Policies and Programs in Russia

The Council for the development of the forest sector of the Russian government has approved the State program "Development of forestry" for 2012-2020 on November 9, 2011 (RU 2011). The main objectives of this program are to improve the efficiency of forest use and to increase conservation, protection and reforestation of forests. The total funding for the State program is more than 472 billion rubles; of these, 270 billion come from the Federal budget, whereas the remaining costs come from regional budgets and private sources. The program is implemented by the Federal Agency of Forestry (Rosleshoz 2011). The program takes into account the concept of long-term socioeconomic development of the Russian Federation and the strategy of the development of the forestry industry in the Russian Federation, both for the period up to 2020 (Rosleshoz 2011).

Moreover, in 2013 (RU 2013) was drafted the state policy guidelines on the use, protection, conservation and reproduction of forests aimed at increasing the forest industry´s contribution to the socioeconomic development of the country by adopting an intensive method for the use

and reproduction of forest resources and for improving timber processing technologies. The adoption of these guidelines will lead to the amendment of the federal programmes: Forestry Sector Development 2013-2020 and Developing Industry and Increasing Competitiveness to 2020 (RU 2013).

The most important long-term laws and regulations of the State policy in the field of forestry and bioenergy is the forest related regulations, and the Energy Strategy for 2030 (RU 2009). According to these sources, the volume of wood in Northwest Russian forests is about 10,000 Mm^3, with some 6,000 Mm^3 of mature stock, of which 4,600 Mm^3 are conifers. The annual increase is 133 Mm^3 and the annual allowable fellings about 118 Mm^3.

The Russian Energy 2030 strategy aims at expanding renewable energy to save domestic fossil-fuel resources, as well as to support climate targets and to make a contribution to environmental protection. In this strategy, the use of local renewable raw materials such as waste from wood industries as feedstock for the regional energy supply will be supported and promoted (RU 2009).

The basics of State environmental policy of the Russian Federation as of September 17, 2010 have been anchored in strategic objectives and principles. The strategic goal of the State environmental policy is the preservation of the health and vital functions of natural systems with the aim of supporting the sustainable development of society, the increase of quality of life, the improvement of human health and demographic situation, as well as for ensuring the ecological security of the country (RU 2009).

Changes in the forest law of the Russian Federation are meant to solve the most pressing problems in the legal regulation of the forest sector. These changes include the optimization of the use of regulations and the protection and reproduction of forests in green zones (Komarova 2013).

The planned approach for the determination of the legal regime of green areas is to balance the need for the development of transport, energy and other infrastructure and interests of companies with that of the environment. The questions in relation to the implementation of the protective role of forests have been regulated. Logging in protected forests will be granted if the establishment of reservoirs or hydraulic structures are planned on the area. In practice, this means that unless underground hydraulic lines, power lines, or communication lines are laid, forests can be cut down (Komarova 2013).

The Russian Government also approved an action plan for the creation of favorable conditions for the use of renewable wood energy for the production of heat and electricity (Rakitova 2013). In general the Russian Government wants to deploy incentives for the use of biomass for the production of heat and electricity, especially in regard to the use of woody residues and wastes from wood supply and processing. Ministries and departments within the government have been put in charge of elaborating proposals for the conversion of coal and peat combustion plants, gathering information about the potential of wood energy for long-term supplies, and examining the logistical feasibility of retrofitting existing burners for the use of forest biomass feedstock. The implementation of these activities will be carried out in coordination with the Ministry of Natural Resources (RU 2013).

The current forest Act and certification systems are not fully adapted to the use of forest biomass for energy production. Nevertheless, within the limits of the sustainability criteria of certification systems, residual wood could potentially be mobilized for energy use.

Dead wood is very important for the conservation of biodiversity in managed forests. The dead trees should from the outset be excluded from the use for energy. Results from study (Sikkema at al. 2013), that remain significant amounts of dead trees (blow debris, wood chips) in the forests of the Northwest.

The Russian Government wants to create a register for oil-fired boilers in the country to assess the possibility of substituting fossil fuels with forest biomass, for example pellets produced from locally available wood residues (i.e. wood not suitable for commercial purposes due to low quality, e.g. bark, thin branches and twigs with a diameter of less than 6 cm, or salvage wood; see RMK 2009).

The Russian Government will start pilot projects for developing the market for bioenergy in 5 regions (Rakitova 2013). In addition, the government wants to implement changes in the laws to boost the energy industry. For example, the Government is ready to provide access to forest areas with poor forest stock to energy producers.

In Rosleshoz a working group for the development of bioenergy was created, which will analyze strengths and weaknesses of the Russian bioenergy industry and advise the Government. It is hoped that by 2014 a complete system to support the bioenergy industry in the country will be ready (Rakitova 2013).

4. Discussion

As progress towards bioenergy development continues, considerations of land-use management and change can cause a certain amount of angst as new renewable resources are sought. With abundant biomass, forests offer excellent renewable resources. There are consequences to clear-cutting forested lands for biomass, however, including loss of habitat, diminution of species diversity, increased GHG emissions, and ecosystem alteration. In promoting the increase of energy consumption from renewable sources, the EU aims to assure a sustainable bioenergy production. In this context, sustainability standards related to land management such as those in the EU *RED* are important to avoid the long-term decline of biological diversity and C stocks and deterioration of forest ecosystem functioning, which are a global responsibility. Although it can be argued that all types of forest biomass and production/procurement systems do not have the same impacts on land and forest ecosystems, the EU aims for an harmonized approach among feedstock types, which should meet the same criteria in terms of sustainability related to land management. Continued investment in forest bioenergy feedstock production is partly dependent on the stability of global market demand and the economic viability of feedstock production and trade. Therefore, to maintain market stability and industry growth, EU policies that are intended to discern sustainable from unsustainable feedstock production should be able to effectively do so in the forestry context of the existing and potential producer countries. Otherwise, EU-mandated sustainability criteria may create uncertainty over the sustainability of forest biomass produced in different countries and their eligibility to count towards EU Member States' targets for renewable energy consumption, Impacts may include decreased investment in the bioenergy industry due to uncertainty over stable export markets, and the need for companies to seek out and establish new economically viable trade relationships outside of the EU

Canada, the US and Russia are signatories to international agreements and conventions on the protection of biodiversity and highly biodiverse areas. Moreover, they have schemes that aim to prevent, to various extents, the conversion of lands with high biodiversity value, lands with high C stocks and peatlands to other land-uses. However, due to their decentralized governance system in which most regulations related to land and resource management are under local jurisdiction (regional, provincial or state), each locality has its own mix of definitions and tools for land use assessment, inventory and reporting, which are developed in order to be operationally applicable in its specific context. This allows for policies to reflect and follow local societal values and land characteristics.

The analysis of the comparison of the anticipated sustainability criteria of the RED with national and local regulations of three important producer countries with contrasting governance structures and forestry contexts illustrates potential challenges in the establishment of overarching sustainability criteria such as the EU *RED*; these challenges relate to:

- differences in land definition, delineation and reporting systems;
- a lack of a uniform definition for SFM;
- difficulties in establishing efficient monitoring/auditing system.

To describe these challenges, the use of 'no-go' areas, as a sustainability standard, notably 'primary forests', as anticipated in the *RED* objectives, is first used as an example. According to the *RED*, primary forests are "forests and other wooded lands of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed"; they are considered a no-go area for biomass sourcing. Forests in primary or pristine state are highly valued by the public and by policy-makers; therefore they were among the first to be preserved in protected areas in North America and Europe (Josefsson 2009).

Protection of remaining forests still in their 'natural state' is globally seen as means to protect biodiversity (Brumelis et al. 2011). However, the question of whether or not ecological processes of a forest have been significantly altered by human action can quickly become theoretically and statistically complex (Josefsson et al. 2009), and the spatial and temporal dimensions of it need to be taken into account (Rouvinen and Jouki 2009). Empirical evidence has shown that landscape-scale patterns and processes have a clear influence on local phenomena; what happens in one forest patch depends on processes that originate its surrounding, i.e. from the landscape (Jonsson et al. 2011). For example, a completely undisturbed forest stand that is located in a human-altered landscape may have had its natural fire regime disrupted, with subsequent alteration to its ecological functions (such as changes in understory vegetation composition and soil nutrient cycling relative to a fire-driven ecosystem). Also, ecological processes in some national parks in Canada such as Banff could be considered significantly altered because of active fire exclusion inside the park (Keane et al. 2009). However, natural disturbance regimes have only been impacted for a short time relative to the natural history of the national parks, and park managers are now using the latest advances in disturbance ecology to guide their planning. Also, human activities in forest landscapes predating the industrial era created a significant legacy on current vegetation composition and forest structure, biodiversity, ecological processes and nutrient availability, even in areas that are currently qualified as 'primary' (Josefsson et al. 2009). There is therefore an increased awareness that most forest ecosystems have been, at some point in time, influenced by humans.

Another difficulty when addressing no-go areas is their actual definition, and their delineation (i.e., the process of determining their boundaries on the land), especially when the term relates to historical benchmarks as opposed to a process-oriented definition (Ridder 2007). To report and map primary forests, following the definition provided by the *EU RED*, one would have to evaluate areas of forests that had originated naturally, and show no indications of any current or past silvicultural treatment, or human influence. These specifications, however, will likely lead to an overestimation of the area of primary forest, since forest attributes such as forest origin and history of silvicultural treatment are often difficult to track down, or not reported consistently among jurisdictions (Stinson 2013; pers. comm). This approach is more likely to produce robust estimates at the national scale or for large ecozones, and is thus appropriate for international reporting to the FAO; however, its accuracy will decline substantially when evaluated at smaller spatial scales. The experience from the United States also exemplifies the struggles, from a legal perspective, to reach agreement on land definitions and delineation, Therefore, economic operators in several countries will face a difficult challenge for reporting on the actual status of the land from which forest biomass is being sourced. One could also think about the challenge, for the regulator, to monitor and audit the proper application of the sustainability standards.

There is also a more fundamental issue with the use of 'no-go' areas as part of sustainability standards, related to confusion of what is, in fact, the features and values associated with this category of land that the regulator intents to preserve. For example, as reviewed by, there is large variation in the definition and use of terms related to natural forests (Rouvinen & Kouki 2008). An example of it is how *primary forest* is defined by different countries in their forest resource assessment (FRA) reporting to the FAO (See Table 16 for examples of definitions). Most forests in Europe have been affected by human activity for centuries or millennia, depending on the region, leading to permanent loss of almost all pristine or primary forests (Josefsson et al. 2009) and fragmentation of remaining forest landscapes (European Environment Agency 2006). According to, the concept of primary forest has little relevance besides a philosophical one for many European countries, such as Denmark, where all forests have at some time been harvested and/or used for agriculture (Brumelis et al. 2011). Therefore, in their reporting to the FAO, many European countries relate *primary forests* to

forests that have not been disturbed by human for a certain number of years, or with *old-growth forest*. Suggested sustainability criteria of Fritsche et al. (2012) also equate protection of primary forests with that of old-growth forests (Table 2). Old-growth forests are stands that originated through natural successions unaffected by human impact over a significant period of time, and/or with a significant contribution of old trees and dead wood often with a multi-layered stand structure (Shorohova et al. 2011). Forests denoted as primary are therefore commonly perceived to be in late succession stages, highly heterogeneous in age and structure. However, not all primary forests are old-growth forests, due to the influence of natural disturbances that bring back forests to early stages of forest succession. Human impact and time since disturbance are two different concepts; primary forests are not necessarily old-growth forests, and all old-growth are not necessarily primary forests. Whereas primary forests *per se* are not specifically protected in Canada or in the United States, the two countries have provisions in regulations for the specific protection of old-growth forests, because they have been shown, and are recognized, to be important for biodiversity. Therefore one could argue that the intent of the regulator to avoid long-term decline of biodiversity might be met, at least partially, by protecting old-growth forests. Using naturalness as an objective measure creates confusion and unnecessary debate (Ridder 2007); it should be rather replaced by wording that reflects the true intent of the regulator, whether it be conserving biodiversity, or minimizing human intervention.

Beside *primary forests*, there are other terms included in the EU *RED* that may not have a direct equivalent in national reporting, such as “highly biodiverse grasslands”. While a framework and very brief description for the world types of grasslands have been achieved by the International Vegetation Classification (Faber-Langendoen & Josse 2010), it is still very skeletal and will need to tie to common international and national lists of grassland types. Another example of complexity of application of land definition is that of wetlands. Although the term exists in Canada, there is not a unique definition and methodology for delineation applied across Canada. For example, the *Federal policy on wetland conservation* (Government of Canada 1991) and the government of Quebec define wetlands as “lands where the water table is at, near, or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water tolerant vegetation” (National Wetlands Working Group 1987; 1988; Ministère du Développement durable, de l’Environnement et des Parcs, 2012). The *Canadian environmental assessment Act* (Minister of Justice 2012a), however, defines wetlands as “swamps, marshes, bogs, fens or other lands that are covered by water during at least three consecutive months of the year”. In the *Forest and range Practices Act* of British Columbia, a wetland is defined as ‘swamps, marsh, bog or other similar are that supports natural vegetation that is distinct from adjacent upland area’ (Statutes of British Columbia 2002) Although no systematic analysis has been performed on this, it is possible that a particular area might be classified as wetland according to one definition, but would not qualified as such according to another. There are already multiple cases of confusion in definitions and methods of delineation of wetlands that have led to challenges in court within Canada (Farnese in press).

Policymakers therefore have to provide clear definitions and explicit methods to delineate areas categorized as ‘no-go’ in the *EU RED*, and to ensure that these have a sound scientific basis. Without clear direction, the sustainability criteria may not be consistently implemented, and their implementation may not be consistently monitored and audited, as different jurisdictions, economic operators and auditors may use different definitions and methods; discretion may be exercised in a way that undermines the intent of protecting forest values. A strong scientific rationale for land assessment will also reduce the risk that the legitimacy of the directive be called into question (Farnese, in press). Some efforts have been done for developing techniques to produce comparable European forest resource estimates (e.g., Tomppo et al. 2008). However, much remains to be discussed about how to then apply these

techniques in worldwide countries with very dissimilar natural disturbance contexts and different forest reporting systems.

Another issue related to the "no-go' areas in the *RED* is that the directive establishes a point in time, i.e. the year 2008, as the baseline for establishing the status of land, against which further activities or land changes are to be tracked (e.g., a land designated as peatland prior to 2008 is considered no-go). Climate change poses the risk that lands may alter their status. For example, climate variation or changes of land use in the surrounding uplands may modify the water balance of wetlands and cause them to lose their status (Conly & van der Kamp 2001). Another example is that of ecotonal ecosystems such as the aspen parkland: it is a transitional zone located between the boreal forest and the prairies, and composed of discrete patches of trembling aspen stands and grassland. Over the years, aspen has encroached on the grassland in some areas, both because of natural causes, e.g. climate variations, and anthropogenic influence, e.g., active fire suppression, whereas in other areas, the shift has been in the opposite direction, i.e., forest to herbaceous vegetation, again due to a mix of natural and anthropogenic causes (Bélanger & Pinno 2008). Therefore, when it comes to using land status as sustainability criteria, it exemplifies the difficulty of disentangling causes of change and isolating signal-to-noise ratios related to a status at a fixed moment in time.

There is as yet no agreed-on paradigm for assessing and regulating biodiversity or carbon stock condition. For instance, in North America, forest management models, which also apply to biomass supply chains, have been developed based on natural disturbance regimes (Burton et al. 2003; Perera et al. 2004; Gauthier et al. 2009). For example, Canadian and American regulations require various amounts of downed woody debris and snags to be left on-site; they also restrict individual cutblock size. The amounts to be retained and cutblock sizes vary between jurisdictions, and also may vary according to stand type and to forest management objectives for a given area. To varying degrees, regulations also require maintenance of stand type diversity at the landscape scale. It can be argued that forest management guidelines, which apply within "go" areas", has greater implications at the global level on conservation of biodiversity and carbon stocks, which is the intent of the *RED*, than simply setting a list of "no-go" areas. The pressure on the matrix surrounding the no-go areas is extremely important (Elbakidze et al. 2013). Preservation of the biodiversity value of old-growth forests, for example, would meet its objectives not only through protection of old-growth forests *per se*, but also with the adoption of management practices that emulate natural disturbances and successional dynamics at the landscape and regional scales (Shorohova et al. 2011).

Criteria and indicators of sustainability that take into account the whole range of forest types and are based on the structure and function of ecosystems (both at the site and landscape level), should be more instructive than a simple emphasis on land status. In most Canadian provinces and American states, and also in voluntary certification systems, regulations and guidelines for forest activities are largely based on specific forest site assessment, with targets and thresholds being locally adapted depending on site conditions. This reflects the adaptation of policies and standards to regional specificities, which is partly based on the reliance on local knowledge and local expert opinion. However, the experience from the Council for Sustainable Biomass Production, as described in Section 3.3, shows that there is no consensus, especially from environmental groups, on the concept of using local assessment as a sustainability safeguard, as it may be considered not sufficient to achieve an adequate level of ecosystem protection. Reviews have shown clear differences between ecological sustainability standards for forest management based on negotiation among local stakeholders, relative to indicators based strictly on scientific evidence, with the former being less comprehensive (Angelstam et al. 2013). Forest management policies and certification systems based on negotiated ecological sustainability standards represent the outcomes of different stakeholders' views; they are likely to mirror national and regional differences and be influenced by a multitude of factors

other than strict evidence-based scientific knowledge (Angelstam et al. 2013). Experience from Russia where despite the prominence of voluntary certification such as FSC and PEFC, questions remain about the true sustainability of forest practices, also highlights the challenges and risks of basing sustainability safeguards on local assessments, but also the challenges of monitoring, verification and auditing.

Existing scientific understanding must be translated into policy through effective knowledge systems (Cash et al. 2003). Key components of such a system include not only the strength of underlying science, but also societal legitimization of scientific knowledge and the "boundary management" that occurs between the scientific community and broader society. Such management encompasses effective communication, translation, and mediation that often appears lacking in highly-charged SFM debates. Communication must be multi-directional and inclusive of key stakeholders whose exclusion will result in conflict, even if the underlying science may be sound. Translation facilitates "[m]utual understanding between experts and decision makers [that can be] hindered by jargon, language, experiences, and presumptions about what constitutes persuasive argument." Communication and translation alone do not guarantee effective decision making when fundamental differences exist between stakeholders. Mediation increases transparency and creates an atmosphere of fairness through decision-making rules and by establishing criteria for decisions (Cash et al. 2003).

Some may argue that governance problems stand in the way of more effective SFM. For example, while many countries formed international organizations over the past twenty years to conduct assessments and develop SFM policy, implementation still too often depends on individual jurisdictions, which in turn results in a patchwork of varying results that do not necessarily address cross-jurisdictional problems. The problem lies, at least in part, with the lack of any mechanism to enforce attainment of baseline expectations for SFM improvement, even if inventories otherwise exist. Due to treaty and constitutional realities in the EU, Canada, US and Russia, establishment of EU and national level SFM programs is nearly impossible.

But consistency and coordination would only be as good as the verification of the outcomes achieved through planning and practices. Each jurisdiction may take a very different approach to defining SFM in the bioenergy context, calling into question what SFM should achieve. In the end, failure to agree on baseline sustainability outcomes for forestry—some common to all of bioenergy, not just forest-based energy—ultimately may have broader ramifications for the entire biomass-to-energy sector in the court of public opinion. On the other hand, the diversity in forest management approaches and paradigms on SFM is inherent to forestry, and this is not likely to change. This underlines that a mix of tools is necessary to ensure sustainability. Supra-national sustainability schemes such as the *EU RED* may need to be part of these tools, as long as regulators are aware of the caveats that such schemes carry and that efforts are made to reduce or eliminate snags . There is also a need to assess the aggregated effects of these various tools, and a need for communication, collaboration and outreach among stakeholders.

Table 17. Operational definitions of primary forests, from country reports on forest resources assessments 2010 as submitted to the FAO

Country	National definition	Comments related to data, definitions, etc.	Comments on the reported trend
FAO definition	Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.	---	---
Canada	The "reserved" plus "not accessed" is classified as primary forest. (p20) "Reserved": Areas that by law are not available for timber harvesting "Accessed": The presence of a transportation route (road, rail, or water) within or on the border of a CanFI cell. No implication of economic accessibility for timber harvesting is intended.	---	---
USA	Includes area classified as "reserved" in US forest inventories which coincide with the IUCN classes 1 through 5, roadless areas in the National Forest System (areas without any improved roads maintained for travel by standard passenger type vehicles - FSH 1909.12, Section 7.11) which are IUCN class 6, approximately 80% of unreserved forest in Alaska based on poor access and private conservation areas in lower 48 States reported in the National Land Trust Census Report and assumed to be predominantly forest for estimate but may or may not be all forest land. (p22)	Includes all Conservation of Biological diversity forest from FAO GFRA 2010 USA report; definition provided is therefore that of Conservation of Biological diversity forest. (p30)	Increase due to increase in IUCN designated forest. (p30)
Russia	Undisturbed by man forest is climax forest (boreal climax of succession) where there are ecological processes are not significantly disturbed. Climax forests are mature and overmature stands of coniferous tree species. All Reserve forests and the mature forest in protected areas are considered as a primary forest (expert data). (p17)	The area of primary forests is not taken into account in the forest management, therefore these data is not present in the State account of forest resources (SAFR). We assumed that all mature and overmature coniferous stands of trees as primary, as they are a climatic climax in terrain of Russia. (p18)	The increase of the [primary] forest area is caused by accumulation of tree stands of low productivity and stands in the remote lands. (p18)

Country	National definition	Comments related to data, definitions, etc.	Comments on the reported trend
Austria	The national category "natural" corresponds to the FRA 2010 category "primary forest". (p24) Level of naturalness determined by Hemeroby classes 1-9 or 5 reduced classes: natural, seminatural, moderately altered, altered, artificial. (p22)	The naturalness level (hemeroby value) is the result of a logical combination of 11 individual criteria: Naturalness of tree composition Naturalness of ground flora Type of tree-regeneration Clearcut areas Recent impact of man State of development Age structure Dead wood Stand structure Diversity of tree species Diversity of the ground layer (p23)	---
Cyprus	National class "Undisturbed by man" corresponds to FRA2010 Definition for "Primary Forests" (p19)	---	---
Czech Republic	"Original forest" and "natural forest" are classified as primary forest. (p24) "Original forest": considered to be the forest where species and spatial composition corresponds to the stand conditions. No indications of human activities and the ecological processes are not significantly disturbed. (p22) Natural forest: Forest established by natural processes but in past influenced by human activities (mostly by harvesting and pasture – not seeding and planting) (p23)	"Original forest" and "Natural forest" are reclassified into FRA2010 category primary forest (p24, Table 4.3.2)	---
Denmark	"Uneven-aged, undisturbed forest" is classified as primary forest (p26). "Uneven-aged, natural forest": Forests established by natural seed fall, where the forest structure is similar to natural forests. (p25)	The identification of primary forest types for this survey is based on a visual assessment of management activity on the sample plots. (p28)	The amount of truly primary forest in Denmark is very limited (in fact only two forests are considered primary: Draved forest and Suserup forest). However, according to the definition in FRA 2010, the forests need not be undisturbed by man to be considered primary but there should be no visible indications

Country	National definition	Comments related to data, definitions, etc.	Comments on the reported trend
			of human activity. In the FRA 2005 and in the MCPFE report only the truly primary forest area was reported whereas the reporting in 2010 is in accordance with the aforementioned definition. (p28)
Finland	We do not have proper definition that could be applied in the field. Primary forests have been included in the category "Other naturally regenerating forest" (p25)	---	---
France	"Forêt non perturbée": Forêt caractérisée par la présence d'une futaie depuis un temps immémorial, exclusivement composée d'essences localement indigènes et sans intervention humaine depuis au moins 50 ans. (p38)	---	---
Germany	No definition provided.	No primary forest exists in Germany. (p21)	---
Greece	No definition provided.	In the MCPFE 2007, no forests undisturbed by man existed in Greece. (p15)	---
Ireland	No definition provided.	No forest areas fitting this description are present in Ireland. (p20)	---
Italy	"Old-growth highly protected forest" is classified as primary forest. Definition: Forest located in the core areas of natural national parks	---	---
Latvia	"Strict and regulatory regime zone of nature reserves" and "Strict regime zone of national parks" are classified as primary forest. (p23) "Strict and regulatory regime zone of nature reserves": Territories untouched by human activities or nearly natural, where unhindered development of natural processes is ensured, in order to protect and study rare and typical ecosystems and their parts. In the zone of strict regime all natural resources are completely excluded from economic	---	---

Country	National definition	Comments related to data, definitions, etc.	Comments on the reported trend
	and other activities (p21), "Strict regime zone of national parks": National parks are broad areas which are characterised by outstanding nature formations of national significance, landscapes and cultural heritage landscapes untouched by human activities or nearly natural, a diversity of habitats, abundance of cultural and historical monuments, and peculiarities of cultural environment. In the zone of strict regime all natural resources are completely excluded from economic and other activities. (p22)		
Malta	No definition provided.	No primary forest exists in Malta. (p14)	---
Netherlands	No definition provided.	No primary forest exists in the Netherlands. (p20)	---
Poland	Strictly protected area of forests in nature reserves and national parks. (p21)	---	---
Portugal	There is no official or commonly used classification or definition for this. The FRA2010 definition was adopted for the report. (p18)	---	---
Romania	"Virgin forest is a natural woodland where tree and shrub species are present in various stages of their life cycle (seedlings, young growth, advanced growth, maturity and old-growth) and as dead wood (standing and lying) in various stages of decay, with a more or less complex vertical and horizontal structures as a result of natural dynamics. This process enables the natural forest community to exist continuously and without limit in time. In virgin forests the dynamics inherent to living systems are connected to ecological properties (including longevity) of the dominant tree species, impact of other organisms (e.g. outbreak of	---	---

Country	National definition	Comments related to data, definitions, etc.	Comments on the reported trend
	insects) and to the impact of abiotic factors related to the substrate, climate and to the complex of topography and water table e.g. wind, snow, flooding). This dynamics may lead to the temporary occurrence of gaps or larger treeless stages. Virgin forests differ within the given phyto-geographic zone, forming specific types of forest communities with characteristic species composition, spatial structure, dynamics and overall diversity due to site conditions related to the position above sea level and topography, macroclimate, and nutrient and water availability. Virgin forests reflect herewith the natural unity of forest community and abiotic conditions, fully rooted in their millennia-long continuous Holocene development." In "Inventory and strategy for sustainable management and protection of virgin forests in Romania"(Biris and Veen 2005, p8)		
Sweden	Includes: -Productive Forestland (national definition) within National parks and Nature reserves with stand age > 120 yrs, -Alpine birch areas -Subalpine spruce and pine forests -Productive Forestland outside National parks and Nature reserves with a high degree of naturalness. (p21)	---	---
United Kingdom	No definition provided.	No primary forest exists in the UK. (p25)	---

5. References

This list does not contain references from Section 3.2. (The United States), which were included as footnotes.

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