

A REVIEW OF CANADA'S FOREST BIOMASS POLICY IN COMPARISON TO NORDIC  
JURISDICTIONS

By

Gabriel Sembrano  
1100183

NRMT 4010, Thesis I  
Mathew Leitch

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Major Advisor

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Second Reader

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## ABSTRACT

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The transition towards renewable energy sources is considered one of the main mitigation measures combating the effects of climate change. The use of renewable energy, particularly those derived from forest biomass, is gaining traction in Canada and the international scene. Nordic countries are seen as leaders in this field and has therefore developed policy programs supporting the use of forest-based biomass energy. This review focuses on four factors influencing the policy development process: (1) Forest governance, (2) Land ownership, (3) Stance on natural gas, and (4) the jurisdiction's policies supporting the use of forest-based energy. The result of this review shows that policy schemes must be coherent at all levels of the government. In addition, all major industries strongly support policy programs, particularly those incentivizing the transition towards renewable alternatives. Lastly, quantifiable goals must be developed to provide a measure on the effectiveness of such schemes.

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## INTRODUCTION

Growing scientific and political concerns over greenhouse gas emissions triggering climate change have spurred the need for energy efficiency and increased use of renewable energy (Soderberg & Eckergerg, 2013). At present, the push towards a bio-based economy- a core concept used within the European Union to refer to an economy based on renewable resources- and in particular, the transition towards a low-carbon economy, is at the epicentre of the political agenda on climate and energy policy (de Besi & McCormick, 2015; Johansson, 2018). Intergovernmental initiatives which called for efforts to combat climate change and adapt to its effects, such as the Paris Climate accord and the EU 2030 Climate and Energy Framework, as well national and sectoral targets for transport, agriculture, and forestry (European Commission, 2016) provided baseline for the development of such policies.

Bioenergy projects must be economically viable for the different actors in the value chain (Lunnan, et al., 2008). Forest biomass used for energy purposes must be able to compete with other uses of the biomass, and at the same time the energy produced from biomass must be as cheap or cheaper than energy produced from competing energy systems (Lunnan, et al., 2008). The costs in these calculations are changing constantly; in particular, fossil fuel costs showarge variations (Lunnan, et al., 2008). As the risks are high and the economic margins in many cases are low, there is a tendancy that investors are reluctant to invest in bioenergy projects (Lunnan, et al., 2008). On the other hand, prices of wood-based fuels have been rising modestly

compared with, e.g. oil and gas, which reduces the economic risk when investing in a bioenergy project (Kabberger, 1997; Metla, 2006). In addition, there are many socioeconomic benefits to bioenergy projects that are not accounted for in the market prices, which is a strong argument for economic support of bioenergy projects (Lunnan, et al., 2008).

Bioenergy projects contribute to many important elements of national and regional economic development: economic growth through production and business expansion (earnings), employment, import substitution (direct and indirect trade on the trade balance), security, and diversification of energy supply (distributed energy) (Lunnan, et al., 2008). Other benefits include strengthening of traditional industries and rural communities (Borsboom et al. 2002).

The forest-based industry provides a very clear and effective platform for generating energy in combination with producing fibres and 'green' chemicals (Lunnan, et al., 2008). As part of this, there is an emerging bio-refinery concept, which foresees a new balance in the use of wood for lumber, pulp, green chemicals, liquid biofuels, and green energy (Lunnan, et al., 2008). In this context, the sector has the potential to deliver increased amounts of energy as a by-product of industrial processing, and for wider use than just a source of local heat (Lunnan, et al., 2008). Therefore the forest-based sector will play an even more prominent role in supplying much-needed renewable energy to Europe, especially important in view of the EU's ambitious targets for promoting green energy resources in the region (Lunnan, et al., 2008).

The Nordic countries have ambitious energy policies to become leaders in cleaner energy production (Khanam et al. 2020). For instance, Denmark is accelerating its wind energy capacity whereas Iceland is a leader in the geothermal energy sector, where 66% of Eneaenergy comes from this source (Askja energy, 2016). Finland and Sweden are pioneers in the bioenergy production sector; e.g. in the former, wood fuels (WF) already suppose over 25% and 23% of the energy produced (Koponen, et al., 2015; IEA, 2013). According to the International Energy Agency and Nordic Energy Research (2016), 87% of electricity production is already carbon-free in the Nordic countries. It is also projected that the use of renewable energy (RE) in the next decades for electricity production will increase (Khanam et al. 2020).

Canada on the otherhand, is facing significant economic and environmental headwinds, partially due to the country's reliance on currently low-priced resource commodities and the greenhouse gas (GHG) emissions associated with recovery, extraction, processing, and utilization of those resources (Stephen & Wood-Bohm, 2016). Fortunately, Canada has an opportunity to become the world leader in using and developing clean and sustainable technologies and processes that utilize biomass to reduce GHG emissions while improving the performance of the Canadian economy (Stephen & Wood-Bohm, 2016). The main problem however, is the relatively high costs of new facilities and to make the industry truly renewable (Cruickshank et al. 2006).

## OBJECTIVE

This review compares how policy is shaped and the forces influencing key decisions between Canada and several leading Nordic countries such as Sweden, Finland, and Norway and on government policies promoting forest biomass energy. We also note the key differences between jurisdictions that are vital in supporting the bioeconomy such as land tenure system, level of forest governance and the government structure and taxation, and natural gas policy will be analyzed and discussed.

## MATERIALS

Policy in its very nature reflects morals and interests currently highly valued by society. Jurisdictions were reviewed based on multiple factors such as: (1) Background on the country's forest industry, (2) Government structure and how these plays in policy development and taxation, (3) how land ownership influences the development of programs designed to involve private and public stakeholders, (4) Stance on natural gas reliance, and (5) Current policies implemented to support biomass policy.

This study utilized technical reports from government databases, journals from academic institutions, and industry/sector publications, and any recent significant journals on sustainable energy are the primary sources of literature.

## LITERATURE REVIEW

### *Role of public policies to support the bioeconomy.*

Public policies are a key government tool to promote the emergence, growth, and sustainability of the forest-based bioproduct sector (Majumdar, et al., 2017). Governments prioritizing the forest bioeconomy have made significant progress by developing policies geared towards encouraging research and development (R&D) and producing bioproducts (Majumdar, et al., 2017). Policy support plays a significant role in increasing the competitiveness of a sector in its infancy stage, and without government intervention, bioproducts have a significantly higher cost than conventional fossil-fuel-based competitor products (Cooke, 2007; OECD, 2009; Cockburn & Stern, 2010; PwC, 2011). Therefore, public policies are necessary to support the emerging bioproduct sector. For example, Sweden, which has a large forest area (53% of its landmass) and a well-established network of district heating, relies on policy support to guide the development of its bioenergy sector (Cooper & Thornley). As a result of its policy mix, Sweden has emerged as a world leader in the bioeconomy, particularly bioenergy use wherein 30% of the national energy supply comes from biomass and 85% of that biomass is forest based (Majumdar, et al., 2017). Since the bioproduct sector competes with conventional products and fossil fuel-based energy sectors for its end products, it is important that governments prioritize policies that will make the bioproduct sector sufficiently competitive (Kant & Wang, 2012).

### *Classification of policy instruments*

One of the most distinctive concepts for the study of public policy in Canada is that of policy or governing instruments (Woodside, 2009). Policy instruments may take the shape, among others, of environmental standards and regulation, economic incentives to correct resource allocation failures, education, capacity building, awareness raising activities and monitoring mechanisms (IPBES, n.d.). Table 1 provides overview of some regulatory and economic instruments that support bioenergy production utilized by other nations.

Table 1. Overview of some regulatory and economic instruments that support bioenergy utilized by other nations.

Instrument	Description	Examples
Renewable energy law	A law sets a target for the share of energy to be supplied from renewable sources. Such a law is often embedded in technology roadmaps or national action plans for renewable energy.	-Renewable Energy Target (Austria)  -Renewable Energy Directive (EU)
Quota or mandate	Renewable fuel mandates or renewable portfolio standards set a minimum level for renewable content in liquid fuels (e.g., gasoline, diesel) or for electricity sold.	-Renewable Fuels Regulations (Canada)  -Renewable Fuel Standard (United States)  -Brazil ethanol blending mandate

Feed-in tariff (FIT)	FIT agreements guarantee electricity supplies a price per unit of generation over a specified timeline, promoting stable production.	<ul style="list-style-type: none"> <li>-Germany Feed-in tariff</li> <li>-Ontario Feed-in Tariff Program</li> <li>-Vietnam Feed-in-tariff</li> </ul>
Capital grants and subsidies	While grants reduce upfront capital costs and help stimulate research, development, and demonstration (RD&D), subsidies provide operational income uncertainty.	<ul style="list-style-type: none"> <li>-ecoENERGY for Biofuels Program (Canada)</li> <li>-Renewable Subsidy Policy of Nepal</li> <li>-ARPA-E PETRO program (United States)</li> </ul>
Soft loan and loan guarantee	Loan programs with low interest rates are made available to eligible projects to open access to financing and reduce net costs of capital for developers.	<ul style="list-style-type: none"> <li>-Support for Biomass Supply Chain (Italy)</li> <li>-Brazil Inova Energia Program (Brazil)</li> </ul>
Tax incentive or credit	Tax mechanisms reduce the net cost of projects by deferring taxes on eligible equipment, thus allowing investment of the savings into other expenditures.	<ul style="list-style-type: none"> <li>-Gujarat Waste to Energy Policy 2016 (India)</li> <li>-American Recovery and Reinvestment Act of 2009 (United States)</li> </ul>
Carbon pricing	These schemes incorporate the cost of negative externalities caused by fossil GHG emissions via a tax or an emissions trading system (ETS).	<ul style="list-style-type: none"> <li>-Sweden Carbon Tax</li> <li>-EU Emissions Trading System</li> <li>-Federal Carbon Pricing Backstop (Canada)</li> </ul>
Auction scheme or tender	Auctions or tenders are held by a government or public entity to contract a certain amount or capacity	<ul style="list-style-type: none"> <li>-Argentina Renewable Energy Auctions- RenovAr Program.</li> </ul>

of renewable energy. Tenders are best suited to larger-scale projects that involve high up-front costs and need guarantees.

Certification scheme	These schemes provide market uncertainty about the sustainability of bioenergy and mitigate the risk of adverse impacts. They can be established by government or the private sector.	-Roundtable on Sustainable Palm Oil (RSPO-RED) (EU) -International Sustainability and Carbon Certification (ISCC EU) (EU)
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Source: NRCAN n.d.

### *The effectiveness of policy instruments in promoting bioenergy*

Ensuring sustainable development is necessary for a successful forest-based bioeconomy (Wolfslehner, et al., 2016). There is a need for a realistic understanding of the potential capacity of forest resources to contribute sustainably (Wolfslehner, et al., 2016). Wolfslehner et al. (2016) also indicated that in a situation with many possibilities, synergies, trade-offs, and uncertainties, indicators can help to avoid unwanted impacts, and support the successful and sustainable bioeconomy development. They can be used to inform policy making, synthesize complex matters and act as tools for decision support (Wolfslehner, et al., 2016).

Public policies supporting the implementation of a biomass strategy, policy coherence and effective transition to governance is key. When pursuing so many

different objectives, policy makers must consider how these objectives interact and potentially inhibit or reinforce each other (Christensen, 2020).

Lenschow et al. (2018) defines a strategy as coherent when it consists of policy goals that can be pursued simultaneously. Put simply, compatible goals make strategies coherent. Similarly, Kern and Howlett (2009) and Huttunen et al. (2014) define policy coherence as the ability to achieve several objectives without encountering trade-offs. For example, the goals of climate change mitigation and economic growth can be considered compatible if countries can reduce greenhouse gas emissions while increasing economic output (Christensen, 2020).

### *Renewable energy and bioenergy policy in Nordic countries*

All Nordic countries have supported electricity and heat generation from renewable resources for a long time (Scarlat et al. 2011). The use of by-products from the forestry industry for energy purposes has been prioritized in both Sweden and Finland (Econ Poyry, 2008; Lindblom & Rasmussen, 2008). The White Paper on Climate Policy of Norway from 2008 provides for policy measures and emission reduction targets (Scarlat et al. 2011). Norway has ambitious goals of becoming carbon neutral by year 2030 where the main objective of their strategy is to reach 100 PJ<sup>2</sup> (2.4 Mtoe) bioenergy by 2020, almost doubling the present figures (Scarlat et al. 2011).

With the exception of Norway, countries outlined in this study are members of the European Union where the development of policies promoting energy from

renewable energy sources (RES) was launched by the European Directive 2001/77/EC (European Parliament and Council, 2001) and kept going with the “20/20/20” climate change and energy sustainability goals in the Europe 2020 strategy (European Commission, 2010). Nevertheless, Norway collaborates closely with EU-sponsored programs such as the Electricity Certificate System (ECS).

Each EU member state has responded to this by proposing different political devices to contribute its share in reaching a reduction of greenhouse gas (GHG) emissions of 20 percent compared to 1990, a share of 20 percent of energy from RES and an increase in energy efficiency of 20 percent (Schusser & Jaraite, 2018)

Finland and Sweden were the first countries to introduce a carbon based tax for fossil fuels since the 1990s (Scarlat et al., 2011). The National Climate and Energy Strategy of Finland adopted in 2008 has established the policy measures up to 2020, and the perspectives for 2050 (Scarlat et al. 2011). It targets at halting and reversing the growth in final energy consumption by 2020 compared to the baseline (Scarlat et al. 2011). A further decrease of at least one third of the final energy consumption was proposed for 2050 (Heinimo & Alakangas, 2009). Finland has set the goal to increase the share of renewable energy sources up to 35-45% by 2020 (Scarlat et al. 2011). The National Climate and Energy Strategy provides for a series of measures to be set in order to meet the requirements established by the EU Renewable Energy Directive 2009/28/EC (European Parliament and the Council, 2009). They include an increase in the use of wood, waste, biogas, heat pumps and windpower (European Renewable Energy Council). This target shall be met by increasing the use of forest biomass and by

increasing the area for energy crop cultivation (Scarlat et al. 2011). The Action Plan for Renewable Energy Sources in Finland requires reaching the renewable energy targets of 25% by 2015 and 40% by 2025 (Scarlat et al. 2011). A policy objective is to expand renewable energy in combined heat and power generation in district heating systems and biofuels in the transport sector (Econ Pöyry, 2009; Framstad, 2009). Energy taxes apply in Finland on transport, heating fuels, and electricity (Scarlat et al. 2011).

Sweden has ambitious goals to be carbon neutral by 2050, which caused them to develop progressive environmental objectives, set in 2008, to decrease the GHG emissions by 40% by 2020 in comparison with 1990 levels (Scarlat et al. 2011; Framstad, 2009; Swedish Energy Agency, 2009). In addition, Sweden was committed to break its dependency on oil by 2020 through the increased use of renewable energy and energy efficiency measures (Scarlat et al. 2011). Sweden's policy mix combined with tradable green electricity certificates were seen as key mechanisms to increase the use of renewable energy (Scarlat et al. 2011). This system also creates an incentive to invest in the most cost-effective solution (Lindblom & Rasmussen, 2008; Nordic Energy Agency, n.d.).

## CANADA

### *Forest Industry background Information*

Forests are a major source of wealth for Canadians, providing a wide range of social, economic, and environmental benefits (NRCAN, 2022). In 2013, production in

the forest sector contributed \$19.8 billion- or 1.25%- to Canada's real gross domestic product (GDP) (NRCAN, 2022). In a global context, Canada has the world's largest forest product trade balance- C\$19.3 billion (2013)- a position it has held for as long as trustworthy trade statistics have been compiled (NRCAN, 2022). While other countries may produce more of one product or another, no nation derives more net benefit from trade in forest products than Canada, and the gap between Canada and the second largest net trader (Sweden) has been expanding continuously since 2009 (NRCAN, 2022). Table 2 presents the 3 main Canadian forest industry subsectors.

Table 2. Three main forest industry subsectors

Forest Industry subsector	Description	Contribution to the Canadian economy
Solid wood product manufacturing	Firms in this area engage in both primary (softwood lumber and structural panels) and secondary (millwork and engineered wood products) manufacturing for domestic consumption and export.	Approximately 44% of the forest sector's contribution to the Canadian economy (as measured by real GDP) in 2013.
Pulp and paper product manufacturing	Companies in this area produce a wide range of products, covering everything from newsprint and household tissues to dissolving pulp and rayon production.	Approximately 36% of the contribution of the forest sector to the Canadian economy in 2013.
Forestry and logging	Firms in this area are responsible for field operations and harvesting of timber, including felling, and hauling it to the mill.	Approximately 20% of the forest sector's contribution to the Canadian economy in 2013.

Source: NRCAN 2022

### *Government Structure*

Under the Canadian constitution, federal, provincial/territorial, or Indigenous governments own and have jurisdiction over most natural resources (GC, 2012a). The federal government has specific authority to make laws related to trade and commerce, navigation, and shipping, seacoasts and inland fisheries, and anything that is not considered “assigned exclusively to the Legislatures of the Provinces” (GC, 2012a). Private individuals such as farmers, woodlot owners, and (in some cases) owners of mineral-bearing lands have surface rights to their lands (Pearse, 1988). For example, 6.2% of Canada’s forests are privately owned (GC, 2012b). However, in most parts of Canada, the respective provincial, territorial, or federal government retains the subsurface mineral (including oil and gas) rights and leases them to organizations for resource use under conditions defined in project approvals and permits (GC, 2016). In addition, provinces let out tenures to forestry companies, which give the latter the rights to manage these lands over long periods of time (Haley & Nelson, 2007)

### *Land Ownership*

Possibly the most important institutions influencing firms in the Canadian forest sector are the tenure arrangements under which forest lands are held (Haley & Nelson, 2007). Public forest land ownership is firmly entrenched as a Canadian institution

(Haley & Nelson, 2007). In keeping with contemporary colonial practice, when Great Britain assumed sovereignty over territories within what is now Canada, all land and resources became the property of the British Crown (Haley & Nelson, 2007).

According to NRCAN (n.d.), most of Canada's forest land, about 94%, is publicly owned and managed by provincial, territorial, and federal governments and only 6% of Canada's forest lands is privately owned (Figure 1). This means that all those jurisdictions- provincial, territorial, and federal- together they could create and enforce the laws, regulations and policies required to meet Canada's commitment to sustainable forest management across the country (NRCAN, n.d.)

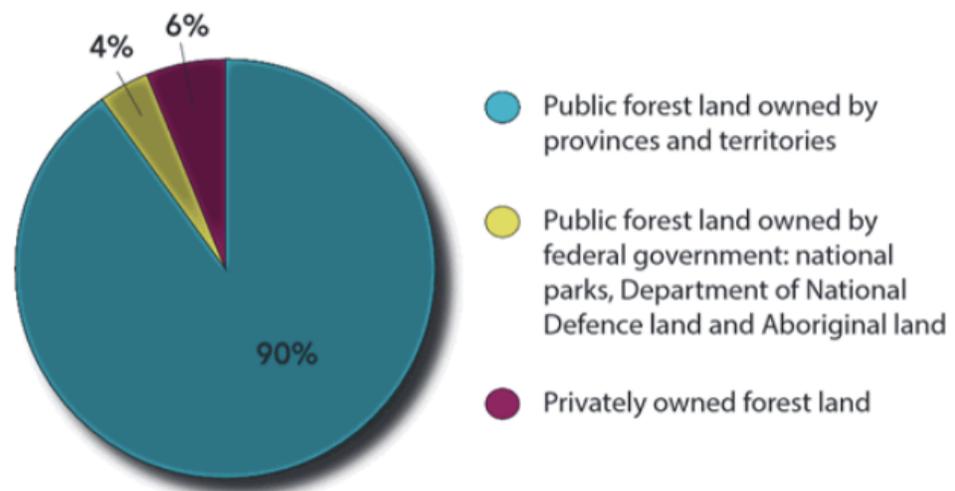


Figure 1. Overview of forest landownership in Canada

### *Natural Gas Policy*

Canada is the world's fifth-largest producer and fourth-largest exporter of natural gas (NRCAN, n.d.). Canadian oil and natural gas provided \$105 billion to Canada's gross domestic product (GDP) and supported almost 400,000 jobs across the country in 2020 (CAPP, n.d.). It also provided \$10 billion on average annual revenue to

governments for the period 2017 to 2019 which helps pay for roads, schools, and hospitals (CAPP, n.d.).

The Canadian natural gas market is fully liberalized (IEA, 2022). Investment in Canada's sector is open to both private and foreign capital, and the commodity price of natural gas is determined by market supply and demand since gas pricing was deregulated in Canada in 1985 (IEA, 2022). North America has an integrated natural gas market, with interconnected gas transmission networks transporting gas freely in both directions across the US-Canadian border (IEA, 2022).

Canadian natural gas policy consists of three fundamental elements: 1) market orientation; 2) respect for provincial jurisdiction over natural resources; and 3) targeted intervention (IEA, 2022). The natural gas policy falls under the more general Canadian energy policy framework, which establishes that investments are made in a competitive and freely functioning energy market (IEA, 2022). A robust energy sector provides long-term security with open access to both product and capital markets (IEA, 2022). Investment in the natural gas sector is open to both private and foreign capital (IEA, 2022). Under Canada's market-based energy framework, companies take business decisions on where new pipeline infrastructure is required based on a project's economic feasibility and expressed interests in open seasons (IEA, 2022).

Federal powers, regarding market regulation and natural gas are primarily associated with the interprovincial and international pipeline transportation of natural gas, and with works extending beyond a province's boundaries (IEA, 2022). This allows the federal government to develop policies and regulate interprovincial and

international natural gas trade and pipelines, codified in the Canadian Energy Regulator Act (CER Act) of 2019 (IEA, 2022).

Legislated timelines for all interprovincial pipelines are included in both the CER Act and the Impact Assessment Act (IEA, 2022). The CER has 450 days to conduct the review and issue a report recommending the project to the Ministry of Natural Resources and Forestry (IEA, 2022). The Integrated Review panel then has up to 6 months for an early engagement phase, and up to 600 days to conduct the review and to issue a report with a recommendation to both the Minister of the Environment, Conservation and Parks and the Minister of Natural Resources (IEA, 2022). Additionally, Bill C-69, which proposes to replace the National Energy Board Act with the Canadian Energy Regulator (CER) Act, was passed in 2018 to improve the environmental protection rules while helping to attract infrastructure investment by providing companies greater predictability and certainty for the approval process (IEA, 2022).

### *Forest Biomass Policy*

Policies and guidelines relating to woody biomass harvesting are found at the provincial and territorial rather than federal level in Canada (Roach & Berch, 2014). In all Canadian provinces except Nova Scotia, New Brunswick, and Prince Edward Island, most (>89%) forested land is provincial Crown land (Roach & Berch, 2014). Federal land makes up a very small portion of the forested land base (0-4% in all provinces except Alberta where it is 8%) (NRCAN, 2011). The direct or shared role of the Canadian Federal government in forestry is focused only 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, Indigenous affairs, and environmental regulations (Manitoba Wildlands , n.d.). With the exceptions of those three provinces mentioned above, where there are significant amounts of private land, natural resources in Canada are primarily under provincial jurisdiction and so forest management policy, including that related to forest biomass harvesting, is largely a responsibility of the provinces and territories (Roach & Berch, 2014). The provinces and territories make the laws and regulations governing the use, management, and protection of the forest resource and have also developed the operational guidelines (Roach & Berch, 2014).

All Canadian provinces have a framework of forest management rules and guidelines in which a commitment to sustainability is made (Roach & Berch, 2014). Indicators of sustainability include: (1) biological diversity; (2) ecosystem condition and productivity; (3) soil and water; (4) role in global ecological cycles; (5) economic and social benefits; and (6) society's responsibility (CCFM, 2006). The provinces' commitments in natural resource policy all include sustainability of timber, soils, wildlife, biodiversity, and water in the mandate (Roach & Berch, 2014). This approach serves as a logical starting point for developing policies specific to forest biomass harvesting (Roach & Berch, 2014). However, biomass harvesting may have a greater impact on these resources than conventional logging because branches and leaves that are removed from sites have a high nutrient content, coarse woody debris needed for wildlife habitat and other uses is removed, and disturbance due to extraction of the

extra woody material may damage sites to a greater degree than logging (Roach & Berch, 2014). Thus, just applying existing forest management guidelines to biomass harvesting may be insufficient to ensure that harvesting of biomass for energy is sustainable (Roach & Berch, 2014).

In addition to all Canadian provinces having a universal framework for forest management, they also have a type of “Forest Act,” which along with its regulations and associated manuals, is generally the main legislation guiding forestry practices on Crown land (Roach & Berch, 2014). These pieces of legislation include requirements for forest management plans, sustainability of the forest resources, and defined utilization standards (Roach & Berch, 2014). Forest biomass harvesting per se is not currently mentioned in most of these acts but falls under the category of “forestry activities” or the like (Roach & Berch, 2014).

The degree to which the regulations and manuals are prescriptive and detailed varies among jurisdictions, with British Columbia near the head of the pack when the Forest Practices Code guidebooks were in effect (Roach & Berch, 2014). Non-legally binding guides and other documents also direct forestry activities, and along with manuals, are the places where on-the-ground woody biomass management and harvesting recommendations are often found (Roach & Berch, 2014). All the provinces have some sort of guidelines related to forest biomass retention and removal from logged sites, including guidance for slash distribution and piling (Roach & Berch, 2014)

Canadian provinces and territories have Climate Change Action Plans or related policy that includes greenhouse gas (GHG) emission reduction targets (Roach & Berch,

2014). In those plans, replacement of fossil fuels with “renewable” or “green” energy sources is identified as a strategy to help achieve the targets (Roach & Berch, 2014). In addition to the Climate Change Action Plans, other provincial or territorial strategies, plans, policies, and acts related to energy have been developed (Roach & Berch, 2014). Currently, none of the plans or strategies place legal requirements on generation of a certain amount of energy from forestry biomass. However, several provinces (e.g., Ontario, Quebec, Nova Scotia, and New Brunswick) have targets for a certain amount (or percentage) of energy generated in the province to come from renewable sources by a certain year (Roach & Berch, 2014).

## FINLAND

### *Forest industry background information*

Forest industry in Finland consists of mechanical (timber) and chemical (pulp and paper) forest industries (Metsäteollisuus, 2014). Finland is one of the world’s largest producers of pulp, paper, and cardboard and one of Europe’s largest producers of sawn timber and these exports account for about a fifth of Finland’s exports (Metsäteollisuus, 2014). The industry is also a significant employer, especially in regional areas (FTP, n.d.), where employs about 42,00 people directly and about 150,000 indirectly (FTP, n.d.).

(FTP, n.d.). Total industrial use of wood is around 67 million m<sup>3</sup> in Finland annually and almost 80% of wood-sale revenues go to private individuals where forest owners' income is some 2 billion Euros (FTP, n.d.).

According to the FTP (n.d.), Finland has a robust legislation surrounding or supporting the increased use of forest biomass for energy. The Finnish Forest Act, the Nature Conservation Act and other legislations are all directed by a long-term action plan. All initiatives outlined in the legislations included in the National Forest Programme 2015 (FTP, n.d.). According to the platform, these legislations promote the use that considers economic, social, and ecological needs heavily.

### *Government Structure*

Finland is a parliamentary Republic under the 1999 Constitution (European Committee of the Regions, n.d.). The Head of State is the President of the Republic, and the Government is led by the Prime Minister (European Committee of the Regions, n.d.). Finland is an officially bilingual unitary state organized decentralized (European Committee of the Regions, n.d.). It has three levels of governance: central, regional, and local (European Committee of the Regions, n.d.).

For Forest governance, the Ministry of Agriculture and Forestry directs and develops forest policy and legislation in Finland and participates in EU decision-making through the Government (Ministry of Agriculture and Forestry, n.d.). Metsähallitus (State Forests), the Natural Resources Institute, and Suomen metsäkeskus (the Finnish Forest Centre) operate under the guidance of the Ministry.

Metsähallitus (State Forests), is a state-owned enterprise that runs business activities while also fulfilling many public and administrative duties (Ministry of Agriculture and Forestry, n.d.). It administers more than 12 million hectares of state-owned land and water areas and is tasked with the responsibility of managing and using these areas in a way that benefits the Finnish society on the greatest extent possible (Ministry of Agriculture and Forestry, n.d.). One of the State Forests' main principles is to cooperate with various organizations and integrate more towards each other (Ministry of Agriculture and Forestry, n.d.). Finland recognizes that transparency is key to improving cohesiveness regarding disseminating information crucial for planning the management and use of state-owned land (Ministry of Agriculture and Forestry, n.d.).

The main service and operational objectives of the Metsähallitus are approved by the Finnish Parliament (Ministry of Agriculture and Forestry, n.d.). At the same time, Parliament decides to what extent proceeds from land sales or land and water area ownership of Metsähallitus will be used in the acquisition of new conservation areas (Ministry of Agriculture and Forestry, n.d.). Based on the objectives set by the Parliament, the Ministry of Agriculture and Forestry decides on the annual targets of Metsähallitus (Ministry of Agriculture and Forestry, n.d.).

Suomen metsäkeskus - The Finnish Forest Centre is a state-funded organization covering the whole country (Ministry of Agriculture and Forestry, n.d.). Its main tasks include promoting forestry and related livelihoods, advising private landowners on how to care for and benefit from their forests and ecosystems, collecting and sharing data

related to Finland's forests, and enforcing forestry legislation (Ministry of Agriculture and Forestry, n.d.). The Finnish Forest Centre operates under the guidance of Ministry of Agriculture and Forestry (Ministry of Agriculture and Forestry, n.d.).

Natural Resources Institute Finland (Luonnonvarakeskus) or simply known as "Luke", is a multidisciplinary research and development organization which works to advance the bioeconomy and sustained use of natural resources and food production (Ministry of Agriculture and Forestry, n.d.). It supports sustainable development through research on forestry, agriculture, food, -game, and fisheries (Ministry of Agriculture and Forestry, n.d.).

### *Land Ownership*

The national government adopts the framework legislation that structures the planning system and other relevant legislation, such as environmental laws (OECD, 2017). Furthermore, the national government may adopt national objectives regarding land use and the regional spatial structure (OECD, 2017). The Ministry of Environment oversees drafting national land-use objectives (OECD, 2017). The national government also indirectly influences spatial policy through its Centres for Economic Development, Transport, and the Environment (ELY Centres), concentrated branches of the national administration (OECD, 2017). Local self-government is ensured by the Finnish Constitution (OECD, 2017). With respect to land-use planning, municipalities meet this responsibility by preparing *Local Master Plans* and *Local Detailed Plans* (OECD, 2017).

Private individuals and families own about 60 percent of the productive forest land in Finland (Forest Finland, 2019). Finland has about 620,000 forest owners this

figure includes the owners and their spouses, as well as the shareholders of consortia and death estates, with holdings of larger than two hectares (Forest Finland, 2019).

Almost 14 percent of the population are forest owners (Forest Finland, 2019).

Forests owned by individuals are often inherited from the preceding generation; for this reason, Finnish forestry is spoken of as family forestry (Forest Finland, 2019).

The state owns 26 percent, companies (including forest industry) nine percent, and other entities five percent of productive forest land (Forest Finland, 2019). State forests are mainly located in northern and eastern Finland, and 45 percent of them are under strict protection by the state enterprise Metsähallitus (Forest Finland, 2019). Figure 2 presents forest ownership in Finland.

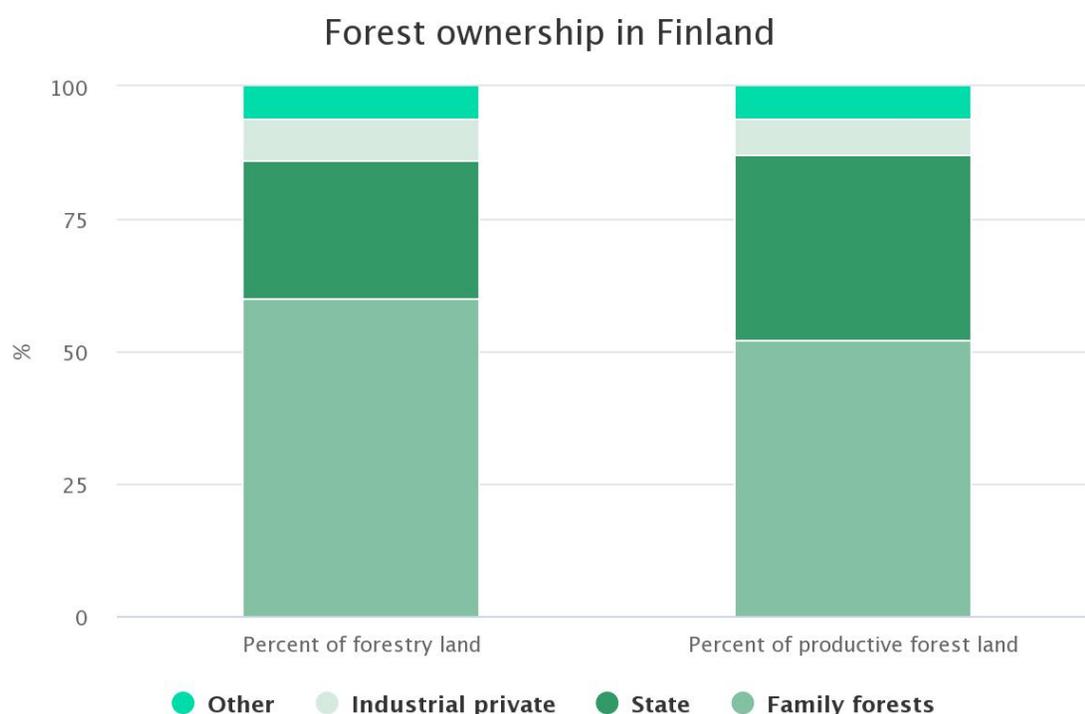


Figure 2. Forest ownership in Finland. Graph update 7.6.2019

Source: Natural Resources Institute Finland (stat.luke.fi) and National Forest Inventory

### *Natural Gas Policy*

Finland does not produce oil domestically (Waselius & Ekqvist, 2020). Natural gas accounts for just some 5% of the total energy consumption in Finland, a country of 5.5 million people (NPR, 2022). Most of the imported oil is refined into gasoline and diesel, and around one-third of petroleum products are used for heating (Waselius & Ekqvist, 2020). Almost all that gas comes from Russia and is used mainly by industrial and other companies with only an estimated 4,000 households relying on gas heating (NPR, 2022). In this jurisdiction, the *Energy Authority* governs the feed-in tariff scheme for renewable energy subsidies, arranges auctions for renewable energy subsidies, and transport infrastructure projects.

Finland's domestic market only consists of one sole oil refiner, Neste Oyj, which the state owns approximately 44% of the shares in the company (Waselius & Ekqvist, 2020). Neste Oyj, which imports crude oil into Finland, operates one Finnish refinery entity comprising of production lines in both the city of Porvoo and the city of Naantali (Waselius & Ekqvist, 2020).

Despite the Finnish oil market not specifically being regulated, the government (Waselius & Ekqvist, 2020). For example, limited liability companies (LLCs) operating in the oil and gas sector pay a general corporate income tax of 20% on their income. Any oil and gas sales also subject to 24% value-added tax (Waselius & Ekqvist, 2020). Additionally, excise duty is levied on most liquid fuels under the Act on Excise Duty on

Liquid Fuels (1472/1994, as amended) and on gas under the Act on Excise Duty on Electricity and Certain Fuels (1260/1996, as amended) (Waselius & Ekqvist, 2020).

Gasgrid Finland Oy (as the gas transmission grid operator) and local gas distribution network operators must contribute to the supervision costs of the natural gas network by paying a natural gas network fee (Currently, the annual fee for gas grid Finland Oy is EUR170,000) (Waselius & Ekqvist, 2020). For distributors, the fee is determined according to their sales profit (1.3 per thousand of the previous financial year's sales profits, or a minimum of EUR6,000) (Waselius & Ekqvist, 2020).

For incoming imports of natural gas, there is generally an additional fee collected for the prevention of oil pollution in the amount of 50 cents per full tonne on the import or transport through Finland of certain oils and refined oil products and this fee is charged double if the oil or refined oil product is transported by tanker and (Waselius & Ekqvist, 2020). Currently, the fee collection has paused because their prevention fund has exceeded EUR10 million and is poised to resume once the capital has decreased below EUR5 million (Waselius & Ekqvist, 2020).

### *Forest Biomass Policy*

Finland is one of the leading countries in the world in terms of using biomass for energy production (Halder, 2014). The Finnish bioenergy production system is strongly connected to the use of biomass from the country's extensive forest resources and

forest industry residues (Linden, 2011). Industrial wood chips, leftovers from forest harvesting, small diameter trees, and forest industry residues such as sawdust and black liquor are widely used for bioenergy production in Finland (Hakkila, 2006). About half of the country's wood production is used for heat and power, either through district heating systems or through combined heat and power (CHP) plants (IRENA, 2018). The most modern of these plants use fluidised bed technology to combust or gasify a wide range of forest residues (IRENA, 2018).

Recent trends indicate that the use of wood chips for producing bioenergy will increase in Finland to meet the country's target for achieving 38% renewables in the final energy mix of 2020 under the Renewable Directive of the European Union (Kallio et al., 2011). This is due to the promotion of the use of renewable energy and climate policy that aims for sustainable energy production and consumption to curb climate change (Energiavirasto, n.d.).

In this jurisdiction, a certain percentage of the total harvested wood is allocated for energy production. In 2013 for example, there was 79.2 Mm<sup>3</sup> of "total drain" (including stems, wood, stumps, logging residues and natural drain) (IRENA, 2018). Forest mass grew by 104.4 Mm<sup>3</sup>, of which nearly one-quarter (25.2 Mm<sup>3</sup>) was left in growing trees, adding to forest wood stocks (IRENA, 2018). Of the 79.2 Mm<sup>3</sup> total drain, 9.2 Mm<sup>3</sup> were lost as uncollected logging residues (which were not deemed economically sufficient value for the forest industry), and 4.7 Mm<sup>3</sup> were a "natural drain" (mainly leaves and very small branches left to enrich the forest soil), leaving 65.3 Mm<sup>3</sup> for use in the economy (IRENA, 2018). This was supplemented by 9.8 Mm<sup>3</sup> of net

wood imports from other countries, so a total of 75.1 Mm<sup>3</sup> of wood was used, primarily 73.9 Mm<sup>3</sup> of roundwood (Alakangas, 2016, Koponen K., et al., 2015). Figure 3 describes how wood is allocated in Finland.

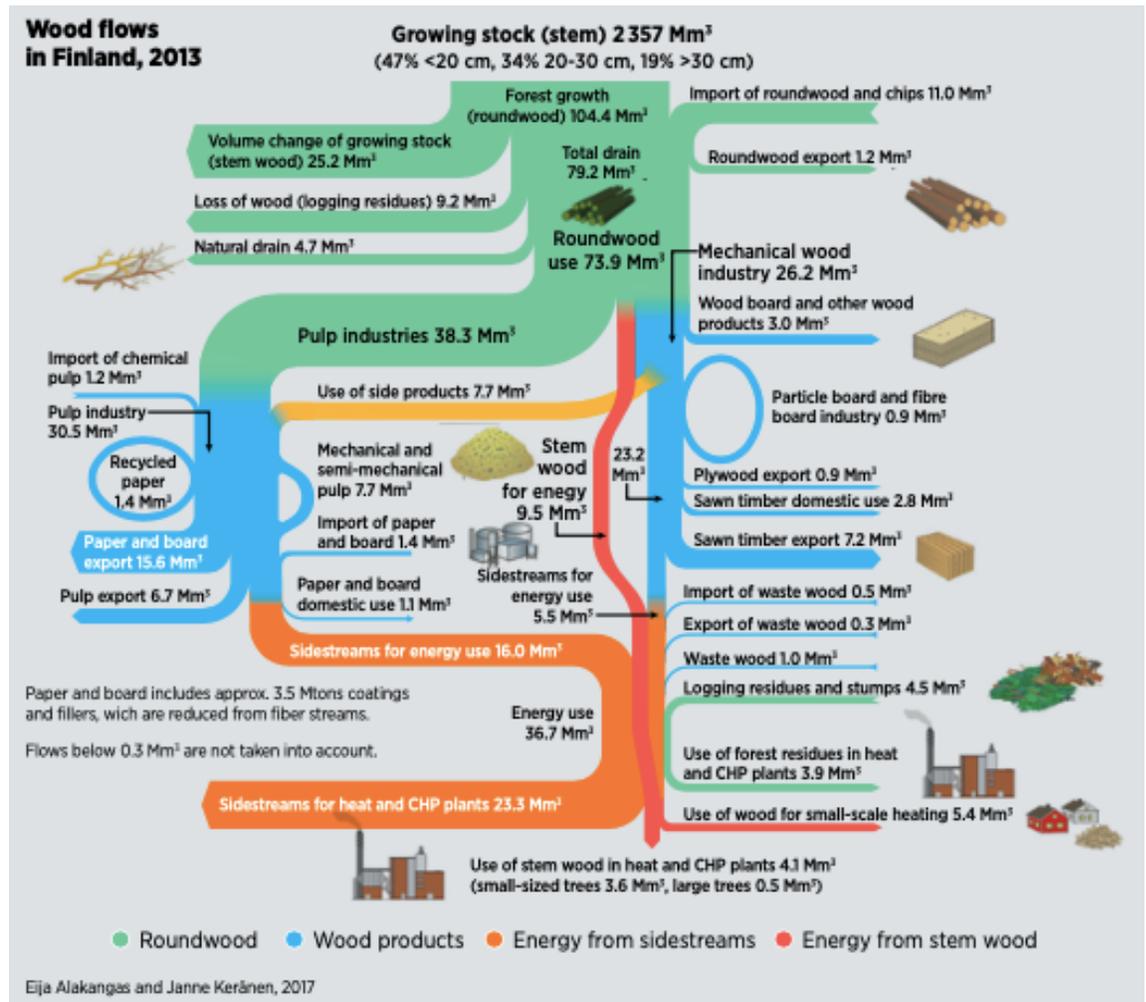


Figure 3. Diagram on how Finland allocates its wood flow.

*Note: Red and orange show energy use. Yellow shows sawmill residues used as raw material. Blue shows different wood-based products. Green shows roundwood (not processed wood). (Source: VTT)*

Of this total roundwood use, 38.3 Mm<sup>3</sup>, or more than half (52%), was used by the pulp and paper industry (IRENA, 2018). Meanwhile 26.2 Mm<sup>3</sup> (35%) of total roundwood use was by the mechanical wood industry, and 9.5 Mm<sup>3</sup> (13%) was stem

wood used for energy (5.4 Mm<sup>3</sup> in small-scale uses in the form of firewood, wood pellets, and wood chips, and 4.1 Mm<sup>3</sup> in heat or CHP [combined heat and power] plants) (IRENA, 2018).

Of the roundwood used in the pulp and paper industry (38.3 Mm<sup>3</sup>), 41% went to paper and board exports and 17% to pulp export (IRENA, 2018). Therefore, nearly three-fifths (58%) were converted to pulp and paper (IRENA, 2018). The remaining 42% constituted side streams for energy use, primarily in CHP plants providing energy for pulp and paper production by industry, but also in municipal CHP plants (IRENA, 2018).

Overall, some 36.7 Mm<sup>3</sup> of the wood output from Finnish forests was used for energy in some way, of which 23.3 Mm<sup>3</sup> was used in large-scale heat and CHP plants (IRENA, 2018). Thus, just less than half of the 73.9 Mm<sup>3</sup> of roundwood harvested in Finland was used for energy, while just more than half of wood went into various products such as timber, plywood, pulp, or paper (IRENA, 2018)

## NORWAY

### *Forest industry background Information*

Forestry is a traditional and important industry in Norway (Eydelman, 2019). Norway's forested area covers about 37 percent of the Norwegian mainland or 119,000 km<sup>2</sup> with 26 percent (approx. 8 million hectares) of productive forests (Campos, 2022). According to the National Forest Inventory of the Norwegian Institute

of Biometric Research presented by Hanne K. Sjolie at Evenstad University's forestry department, the annual increment of forests has increased from 10 million cubic meters in 1933 to 25 million in 2015. At the same time, total harvesting is maintained on the level of approximately 10-12 million cubic meters annually resulting in an increase of the current growing stock to 950 million cubic meters which exceeded amount compared to 1933 threefold (Eydelman, 2019).

About 50 percent of the harvested timber is used by sawmills in Norway (Eydelman, 2019). There are 225 sawmills operating on an industrial scale (Eydelman, 2019). Around 25,000 people are employed in the forest-based sector making Norway one of the world's leader in the development of wooden structures- bridges and buildings (Eydelman, 2019).

Wood and forest products cover about 11 percent of the Norwegian mainland product export (Eydelman, 2019). Despite the 2005-2014 crisis in the industry, a crisis of spruce-dominated forestry, known as "forest decline" or "Waldsterben" which was presumable caused by high emissions of air pollutants (Jandle, 2020), paper products have the highest export values of all the forest-based products (Eydelman, 2019). This sector of Norway's forest industry is slightly less than the export from the fishing industry, somewhat higher than both the aluminum and natural gas exports, but twice the value of high-technology exports (Eydelman, 2019). The pulp and paper industry is the largest producer of bio-energy in Norway (Eydelman, 2019).

### *Government Structure*

Norway is a constitutional hereditary monarchy where the government is comprised of the prime minister and the Statsrad (Council of state) nominally chosen by the monarch with the approval of the Storting (Stortinget), the country's legislature (Britannica, n.d.). Until 2009 the Storting operated as a bicameral body, though most matters were addressed in unicameral plenary sessions (Britannica, n.d.). Only when voting on laws was the Storting divided into two houses where one-fourth of the members were chosen to constitute the Odelsting, or lower house (Britannica, n.d.). Bills had to be passed by both houses in succession (Britannica, n.d.). In 2009 the Lagting was dissolved, and the Storting became permanently unicameral (Britannica, n.d.). Executive power is vested formally in the king, but is exercised through the government, headed by the prime minister (IEA, 2022). As a member of the European Economic Area (EEA), Norway shares internal market legislation with the EU and has therefore implemented several EU directives and regulations related to energy (IEA, 2022).

The Finnmark Act, adopted by the Storting in 2005, transferred some 95 percent of the *fylke* (county) of Finnmark from state ownership to its residents through the establishment of the Finnmark Estate (Britannica, n.d.). The act recognized that the Sami people, through protracted traditional use of the area, had acquired individual and collective ownership and the right to use its land and water (Britannica, n.d.).

Norwegian forest governance has three schemes of area protection relating to forests (Follo et al. 2015). According to a report by Follo et al. (2015), the strictest form

is nature reserves, national parks have a weaker form of area protection, and landscape conservation areas have the least strict protection system. As per this report, of the total forested area in Norway, 6.1% is within one of the three schemes.

### *Land Ownership*

The Odelsrett is a medieval Scandinavian law, which still governs land ownership in Norway (Thornton, 2019). This law gives direct descendants, in families who have owned land for more than 20 years, a first right to purchase land (Thornton, 2019). The Odelsrett thus ensures the oldest child of the owner of agricultural property the first right to purchase to the property within a set timeframe, when the property has been owned by the current owner for a set amount of years, and when the property is of a certain minimum size (acres) (Fuglestad & Palmer, 2019). One consequence of this legislation is that there are very few foreign landowners, and absentee landlords are rare (Thornton, 2019). In addition, it has been argued that this law has maintained a long-lasting agrarian culture in Norway, however, it has been criticized for not attracting a younger generation to develop more innovative land management practices (Thornton, 2019). The Odelsrett has maintained small land holdings (average 50ha) in Norway, resulting in a diverse and shared land ownership pattern (Thornton, 2019). Most land holdings support both agricultural and forestry management, which has led to the development of an integrated land management system, with relatively little conflict between management objectives (Thornton, 2019).

Forest management in Norway is generally managed by the forest owners themselves (Follo et al. 2015). Active private forest owners are often members of one of the two forest owner's organisations, Norskog or the Norwegian Forest Owner's Federation (Follo, Nybakk, Barstad, & Talbot, 2015). While Norskog is nationwide, the Forest Owner's Federation is organized into eight regional cooperatives (Follo, Nybakk, Barstad, & Talbot, 2015). The productive forest is distributed between 125,000 forest properties and about 79 percent of this area is owned by private individuals (Campos, 2022). Norwegian forests have been exploited intensively for export of roundwood, sawn timber, and wood tar for hundreds of years and in addition, there is a long-standing tradition of using forests for domestic animal grazing and game hunting (Campos, 2022).

### *Natural Gas Policy*

Norwegian production of natural gas covers approximately 3% of global demand. It also ranks as the third-largest exporter of natural gas in the world, only behind the Russian Federation and Qatar (IEA, 2022). The oil and gas sector are Norway's largest one based value added, revenues, investments, and export value (IEA, 2022). As such, the sector plays a critical role in the Norwegian economy and in financing the Norwegian welfare state (IEA, 2022). The country's export revenues from the petroleum industry were estimated to be over NOK 800 billion (EUR 80 billion) in 2021, and doubled in 2022 (IEA, 2022)

One of the overarching principles of Norway's management of its petroleum resources is that exploration, development, and production must maximise value creation for society, and that revenues must accrue to the Norwegian state and therefore benefit society as a whole (IEA, 2022). Along these lines, the Norwegian state secures a large share of the value creation through taxation and through a system known as the State's Direct Financial Interest (SDFI) in the petroleum industry (IEA, 2022). Given the significance of Norway's oil and gas to the international market, the Norwegian government created the Government Pension Fund Global in 1990 which is financed by the revenues from oil and gas production (IEA, 2022). This program is intended to finance public pension expenditures, provide benefits to both current and future generations from petroleum revenues, and protect the country's long-term economy from volatility in oil and gas revenues (IEA, 2022).

Norway's role as a gas exporter to the European Union (EU) is even more pronounced, accounting for around 25% of EU gas demand, second after Russia (30% in 2021) (IEA, 2022). Given the severe economic sanctions imposed towards Russia for the invasion of Ukraine and the European Union's attempt to phase out Russian energy imports, Norway has agreed to increase gas supplies to the EU, which have grown considerably in 2022 (IEA, 2022). Last year, Norway overtook Russia as Europe's biggest gas supplier, with Equinor (EQNR.OL) the top exporter, after Russia's Gazprom (GAZP.MM) cut off much of the gas on which Europe previously depended (Adomaitis, 2023).

Despite being the world's third-largest gas exporter, and one of EU's main gas producers, Norway's domestic gas consumption was just 1% of its total final energy consumption where demand comes mainly from the industry sector (92%), followed by electricity and heat generation (6%) and the transport sector (2%) (IEA, 2022). Because domestic gas consumption is so minimal, security of supply is not considered an issue in Norway (IEA, 2013).

Regarding taxation, the electricity and fossil fuel taxes are both crucial parts of Norwegian energy policy, greatly affecting bioenergy competitiveness (Tromberg, Bokesjo, & Solberg, 2008). Currently, the electricity tax is 96.7 NOK/MWh (approximately 3.4 EUR/GJ), However, the industrial sectors are exempted from this tax (Tromberg, Bokesjo, & Solberg, 2008). The total tax on oil use for heating is approximately 100 NOK/MWh (approximately 3.5 EUR/GJ), in addition, gas and diesel used in vehicles are also subjected to this tax system (Tromberg, Bokesjo, & Solberg, 2008). Currently, the tax on gas is 0.59 EUR/L (including a CO<sub>2</sub> tax of 0.1 EUR/L), while the corresponding tax on diesel is 0.44 EUR/L (including a CO<sub>2</sub> tax of 0.07 EUR/L) (The Norwegian Petroleum Industry Association, 2007).

### *Forest Biomass Policy*

Bioenergy stems mainly from forestry and forest industry in Norway today, and wood is assumed to be the major raw material (Sjolie et al. 2010). It is also assumed to be the largest potential bioenergy source (CICERO, 2021). However, only 5% of the energy produced is bioenergy from forest biomass, compared to about 28% in neighbouring Sweden and Finland (NIBIO, n.d.). Currently, less than half of the actual

forest increment is harvested, causing a rapid accumulation of the growing stock and an increasing potential for bioenergy supply (Sjolie, Tromberg, Solberg, & Bolkesjo, 2010). The maximum volume that can be harvested sustainably in Norwegian forests, i.e. the volume that can be harvested without the need of reducing it later, is about 21 million (M) solid m<sup>3</sup>, of which harvest residues, trees on cultural land and road sides make up 5.6 M m<sup>3</sup> (Sjolie, Tromberg, Solberg, & Bolkesjo, 2010). The actual annual harvest accounts for 11.5 M solid m<sup>3</sup>, the yearly non-declining additional biological potential is thus 9.5 M m<sup>3</sup>, corresponding to an energy gross output of about 19 TWh/year (Gjolsjo, 2006).

This jurisdiction's national goal is to increase the production and use of sustainable bioenergy (NIBIO, n.d.). Here, the potential for increased use of wood for bioenergy production is high as the annual volume logged is far lower than the regrowth (NIBIO, n.d.). However, the pressure to shift towards using forest biomass for energy remains relatively weak as Norway already produces enough renewable energy through hydroelectric power plants (NIBIO, n.d.).

A 2021 report by the Center for International Climate Research exploring the potential of bioenergy from forests to contribute to the green transition of Norwegian society concluded that bioenergy based on forest biomass can become an important but limited part of the green transition. Currently, bioenergy from forest is significantly constrained by the more profitable timber production for buildings and industry use of fiber, leaving the lowest quality biomass for firewood, pellets, and chips for firing production.

Currently, biofuel production from forest biomass is not competitive with fossil-based fuels but is facilitated by Norway's biofuel mixing requirement for diesel and gasoline sold for land transportation (CICERO, 2021). It is also hampered by very low industrial production capacity and a need to import almost all the biogenic resources for production (CICERO, 2021). The report however stated that over time, with higher carbon taxes and prices, the competitiveness of biofuels compared to fossil fuels will increase.

## SWEDEN

### *Forest industry background Information*

The Kingdom of Sweden (hereafter "Sweden") lies in the north of Europe and borders the countries of Norway and Finland, and the bodies of water of the Baltic Sea, Kattegat, and Skagerrak (IEA, 2019). It has an area of 450,000 square kilometres, around two-thirds of which is covered by forests (IEA, 2019). It combines an open-market economy with a generous welfare state (IEA, 2019).

As in all developed economies, services are the largest sector (74% of GDP in 2017) and the country's industry (25% of GDP) is led by exports and has traditionally focused on processing the abundant local forest and mineral resources (IEA, 2019). It is also home to several large multinational companies, Sweden's major export articles include vehicles, machinery, pulp and paper, pharmaceuticals, and oil products (IEA, 2019). The primary sector (which includes forestry, agriculture, and fishing) accounts for 1% of the GDP (OECD, 2018).

Sweden is a forested country with a large, export-oriented forestry sector (Lindahl, et al., 2015). Seventy percent of the Swedish territory is covered by forests (EURISY, n.d.). 115,000 people are employed in the sector, which generates an export value of £12 billion (EURISY, n.d.). Almost 90 percent of Sweden's manufactured pulp and paper is exported which places the Swedish forestry industry third in the world's exporters of these products (Swedish Forest Industries, 2016). The government and the industry own around half of the national forests, while the other half is owned by over 300,000 individuals (EURISY, n.d.).

Because of centuries of intense exploitation and absence of afforestation large areas of forest had been depleted by the end of the 19<sup>th</sup> century (Swedish Forest Authority, 2015). Since then, Sweden strongly recognized its forests as a national asset and resource and hence developed a forest policy (Swedish Forestry Act) that placed equal emphasis on two main objectives: production goals and environmental goals (Skogsstyrelsen, n.d.). The Swedish Forest Agency (or more commonly known as "Skogsstyrelsen") is the administrative body in charge of implementing the forest policy (Skogsstyrelsen, n.d.). It is placed under the Ministry of Rural Affairs and Infrastructure and receives direction from the government with goals and the organizational financial framework on an annual basis (Skogsstyrelsen, n.d.).

### *Government Structure*

Sweden is a constitutional monarchy with a parliamentary democracy (European Committee of the Regions). The Parliament (*Riksdag*) is unicameral, and its members are elected to a four-year term (European Committee of the Regions). This

government is led by the Prime Minister, chosen by the Parliament on the principle that a person can only be accepted as a Prime Minister if he or she does not receive a majority of active negative votes by the members (European Committee of the Regions).

Sweden is a unitary and decentralized State; the Constitution recognises local self-government in certain areas and delegates certain responsibilities to the local administrations (Government portal, 2015). There are three levels of governance: central, regional (formerly known as counties), and municipal (European Committee of the Regions). Forest governance is the joint responsibility of both regional and local levels where at the regional level, growth and development programs are enacted, whereas environmental protection is at a local level (European Committee of the Regions). On a voluntary basis, all levels of the government can be involved in developing policy programs for energy, industrial and commercial services (European Committee of the Regions).

### Land Ownership

In Sweden about 28 million ha is covered by forest (Forest statistics, 2013) of a total land area of 41 million ha. Out of 28 million ha forest about 23 million is classified as productive forest land (Lidestav, et al., 2015). The total number of private forest owners in 2011 was 321 thousand 199 thousand men and 1244 thousand women

(Lidestav, et al., 2015). They own about 51% of the productive forest area, private owned companies 23%, state owned company 14%, other private owners 6%, state authorities 3%, and other public owners 2% (Swedish Forest agency, 2015).

In Sweden, there are at least three layers of tenure regimes influencing forest use and forestry: (1) private land tenure, (2) usufructuary rights held by the Sami people in the northern parts of Sweden, and the (3) right of public access (Swedish Forest Authority, 2015).

The Swedish Forest Agency plays an important role in overseeing regulations under the Swedish Forestry Act such as forest management practices, providing guidance and support to private forest owners, and promoting sustainable forestry (Swedish Forest Authority, 2015). In addition, it also has the authority to enforce parts of the Environmental Act (Swedish Forest Industries, 2016).

Sweden recognized that since nonindustrial private forest landowners (NIPF) hold most of the productive forest area, integrating them into sustainable management practices would produce benefits from an ecological, economic, and social standpoint (Kittredge, 2003). One such program is the Forest Stewardship Council (FSC) which created the national standards that gives stakeholders (in such case, private landowners) equal influence in developing sustainable forest management practices (WWF, n.d.).

Together with the national government, Swedish nonindustrial private forestland (NIPF) owners have historically influenced the forestry market and negotiated improved prices with industrial purchasers of wood (Kittredge, 2003). This

collaboration proved extremely beneficial as it was able to achieve broader owner objectives, including increased use of forest biomass for energy generation (Kittredge, 2003).

### Natural Gas Policy

Sweden has minimal fossil-energy resources and relies on imported oil and natural gas (OECD, 2020). At the same time, the country possesses important supplies of renewable energy, mainly in the form of biomass and hydropower (OECD, 2020). Although fully open to competition, the Swedish oil markets dominated by the Saudi-owned company Preem, which owns two of the country's five refineries, with its refining capacity capable of processing around 90% of the country's crude oil supplies in 2018 (OECD, 2020). By comparison, the natural gas market is characterised by a small number of companies covering both the wholesale and retail market with the country's gas supply entirely imported from Denmark through a single pipeline, the Baltic Gas Interconnector (OECD, 2020).

The Ministry of the Environment and Energy (MEE) is responsible for energy policy (IEA, 2019). Within the Ministry, this task has been delegated to a relatively small (25 people) Division for Energy, as most policy implementation is delegated to governmental agencies (IEA, 2019). Under this ministry, the Swedish Energy Agency (SEA), is the government agency in charge of implementing most of the energy policy and is responsible for energy forecasts and projections, provide insight on energy

statistics and policy analysis, administers the electricity certificate system, implements the sustainability criteria for biofuels, etc. (IEA, 2019).

Sweden's gas market legislation is based on EU directives and regulations. They took a free-market approach to energy policy, which puts an emphasis on competition in ensuring efficient energy supply within a policy framework that aims to encourage renewable-energy sources (OECD, 2020). For energy prices and taxes, all energy prices are freely determined by the market in Sweden, except for electricity and gas network tariffs, which are regulated ex-ante by the Energy Markets Inspectorate (EI) (OECD, 2020). Energy products may be subject to energy, CO<sub>2</sub>, and sulphur taxes and rates of tax vary by fuel and according to whether the fuel is used for heating or in transport; whether by manufacturing, energy or household consumption; and , in the case of electricity, what the intended purpose is (OECD, 2020).

Sweden's energy policy has for long aimed for a sustainable energy system with a high share of renewable energy sources (RES) (IEA, 2019). In line with that vision, Sweden is concentrating on improving its energy efficiency and increasing renewable energy use from an already high level (IEA, 2019). In its energy market policy, the government aims to promote efficient markets with a well-functioning competition that ensures a reliable energy supply at internationally competitive prices (IEA, 2019).

### *Forest Biomass Policy*

Biomass utilization has increased significantly in Sweden over the last few decades (Kumar, Adamopolous, Jones, & Amiandamhen, 2021). Although forest

resources and agricultural crops are the main biomass categories available in Sweden, a small percentage including logging residues and energy crops are directed towards energy generation (Kumar, Adamopolous, Jones, & Amiandamhen, 2021). More than half the land area of Sweden, about 57% or 23 million hectares is covered by forests, making forest biomass the likely source for any substantial increase in renewable energy use and sustainable energy production (Kumar, Adamopolous, Jones, & Amiandamhen, 2021).

Bioenergy today makes up 38% of the final energy use in the Swedish economy and is the largest energy source (Svebio, 2022). The bioenergy use is highest in the heating sector, mainly as fuel in district heating, and in the industrial sector, particularly in the forest industry (Svebio, 2022). The key policy supporting this scheme is the *Renewable Energy Directive 2009/28/EC* which requires Sweden to achieve a renewable energy share of 49% by 2020 (Swedish Energy Agency, 2022). Since then, Sweden has further raised this goal so that its renewable energy share should be at least 50% of the total energy use (Swedish Energy Agency, 2022).

Another policy scheme supporting increased use of forest biomass for energy generation is the *green electricity certificate system* (Swedish Energy Agency, 2022). This certification is a market-based support scheme (Norwegian Ministry of Petroleum and Energy, 2023). Started up in 2012, this policy shared Norway and Sweden's goal of increasing electricity production based on renewable energy sources by 28.4 TWh by 2020 (Swedish Energy Agency, 2022). Norway has undertaken to finance 13.2 TWh of

this, and Sweden will finance 15.2 TWh, regardless of where the production is placed (Swedish Energy Agency, 2022).

## CONCLUSION

This review recognizes the uniqueness of each jurisdiction's approach for supporting forest biomass for energy production. Results from this review indicate that for stakeholder involvement, particularly in jurisdictions with most of its forests managed privately, more involvement from forest owners can be seen when a dedicated agency is responsible for creating policy schemes incentivizing active participation.

Currently, none of Canada's plans or strategies place legal requirements on generation of a certain amount of energy from forest biomass. Nordic jurisdictions on the other hand require a certain percentage of total power generated to come from renewable sources. Sweden and Finland for example generate approximately 28% of their power produced from forest biomass.

From a social standpoint, it is also evident that if a jurisdiction is dominant, active player dominant and active in the global supply for natural gas, economic and social pressures to shift towards forest biomass energy production are low.

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