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Bioeconomy in Northwest Russian region

Forest- and waste-based bioeconomy in the Arkhangelsk region, Russia

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Forest- and waste-based bioeconomy in the Arkhangelsk region, Russia

Working Paper

By Anna Berlina and Alexey Trubin, 2018

Contents

1 Introduction

This study is one of the outcomes of the project 'Nordic-Russian bioeconomy pre-study' financed by the Nordic Council of Ministers in 2017[1]. The project aimed at strengthening cooperation and networking between the Nordic countries and Russia in the field of bioeconomy, and at enhancing understanding of the institutional framework with regards to the utilization of forest and waste-based resources in Northwest Russia. The further purpose of the project was to identify topics and develop concrete ideas for further Nordic-Russian cooperation and research in forest- and waste-based bioeconomy.

This study provides an overview of the current status and support framework for bioeconomy in the Arkhangelsk region, Russia. It presents some key institutions and stakeholders in driving bioeconomy development in the region, and analyzes key challenges and opportunities in transition to a bioeconomy.

This study draws upon qualitative interviews with the representatives from the regional administration, businesses, NGOs and academic actors in the Arkhangelsk region conducted during the two visits to Arkhangelsk in 2017. Among the secondary sources used in this study are strategic policy documents, presentations from the companies and regional authorities during the meetings in Arkhangelsk and companies' websites.

The bioeconomy can be defined as an economy based on land and marine-based natural resources including eco-systems services and bio-waste. The bioeconomy produces the most vital goods: food, drinking water, breathable air, and energy. Increasingly, the bioeconomy is also seen as offering a green alternative to the fossil fuel-based economy that is largely responsible for climate change (Bryden et al., 2017).

The bioeconomy, as a provider of vital subsistence resources, urges us in our research to consider fundamental issues as access to food, shelter, and clean water as they are basic needs and rights. Simultaneously, the bioeconomy, with its territorial nature, is embedded in the communities and other social systems, and depends on natural resources that have many social and cultural uses. Altering any or all of these social and biological systems to 'grow the new bioeconomy' has social and human implications and, therefore, requires not only technical but only social and institutional changes in society (Bryden et al., 2017).

Biological resources are mostly located in rural and coastal areas. Bioeconomy can – if embedded economically and socially – therefore play an important role in rural development by providing employment, contributing to business growth and security of e.g. energy supply, and ensuring positive societal and economic impacts (Smed Olsen et al., 2016; Berlina and Mikkola, 2017; Refsgaard et al., 2017; Grunfelder et al., 2018).

Through production and conversion of renewable biological resources into food, feed, bio-based products and bioenergy, the bioeconomy contributes to tackling climate change and environmental challenges, improving food security and reducing dependence on imported fossil fuels. Moreover, bioeconomy can be answer to a more regionally balanced social and economic development.

[1] The project was implemented in cooperation with the Foundation of President Program Participants in the Arkhangelsk region, the University of Eastern Finland - Spatia Centre for Regional Research and Centre for Sustainability and Resilience from January 2017 until December 2017.

The study was conducted jointly by Nordregio and the research partner in the Arkhangelsk region in Russia. It is based on the expert interviews with various stakeholders from the region (public authorities, business representatives, environmental NGOs and researchers), desk research and unpublished material provided by the interviewed actors.

2 General description of the Arkhangelsk region

The Arkhangelsk region (or Arkhangelsk oblast) is located in the northwestern Russia. It borders with the Republics of Komi and Karelia, Kirov, Vologda and Murmansk regions. It consists of 20 administrative districts, the Nenets Autonomous District, as well as the islands that constitute the archipelagos Novaya Zemlya and Franz Josef Land. The total territory of the region is 58,99 million hectares, of which 41,8% is forested.

Figure 1 The Arkhangelsk region on the map of the Russian Federation. Source: (CCGS, 2008)

The region lies on the Barents, Kara and White seas. The largest rivers in the region are the Northern Dvina, Pechora, Onega and Mezen. The climate is moderately continental, with the average temperatures in January -12,4C and in July + 15,2C.

The administrative center of the region is the city of Arkhangelsk, located on the White Sea. Other largest settlements are the cities of Severodvinsk, Kotlas, Novodvinsk, Koryazhma and Mirny. The economy of most cities and towns has a single-industry structure, making them the so called 'mono' cities. There are several wood processing industries located in close proximity to the city of Arkhangelsk, and pulp-and paper mills in the cities of Koryazhma and Novodvinsk.

When it comes to the road infrastructure, 62% of the public roads in the Arkhangelsk region are paved roads. The road network can be characterized as underdeveloped in comparison with the central regions of Russia. The road density is about 28 km per 1000 km. There are two railway lines surpassing the region: Moscow - Arkhangelsk and Konosha - Vorkuta. There is also a regional railway line connecting Arkhangelsk and Karpogory cities.

The cities of Arkhangelsk and Onega have an advantageous geographic location owing to a year-round navigation ports and the Northern Sea Route, allowing to benefit from the export and transit

activities. The relative proximity to the markets and abundance of forest resources are among the regional strengths, and the building blocks for the economic development in the region.

3 Forest resources and their management

Characteristics of forest resources and their governance

The Arkhangelsk region comes second in the Northwestern Federal District in Russia in terms of standing volume of timber, and the timber industry has traditionally been an important manufacturing sector in the region.

The forested area in the region covers a total area of 22,3 million hectares. Conifers (pine and spruce) are the dominant species in the forestry fund accounting for about 80%, while deciduous species (birch and aspen) account for another 20% (MNR 2016).

In the Russian Federation, forest is owned by the state, and most of the business activities are based on the long-term rental contracts. 14 million m^3 of forest has been leased to businesses.

Timber harvesting is the main forest utilization activity in the Arkhangelsk region. In 2015, about 9.9 million m^3 of timber was logged, which stands for ca 70% of the total allowed cutting volume in the leased forest areas (MFA 2016).

Since the 1930s, there has been an intensive forest exploitation in the Soviet Russia, when the cutting area greatly exceeded the annually allowed cutting area in many regions, including Arkhangelsk. The state of forests in Russia has generally improved since the '90s, and the forestry businesses in the region claim to have forest restauration as a high priority. The importance of the Scandinavian experience on forest restauration was emphasized in this regard (interviews 2017).

Logging activities are mainly concentrated in the north-eastern part of the region. About 6 million m3 of mature and old growth commercial forest is located in the north-western part of the region, where infrastructure is poorly developed. Timber harvesting in these areas requires substantial capital investments into road infrastructure, energy systems and housing construction. Timber harvesting in this part of the region is currently considered economically not viable (MFA 2016) (Figure 2).

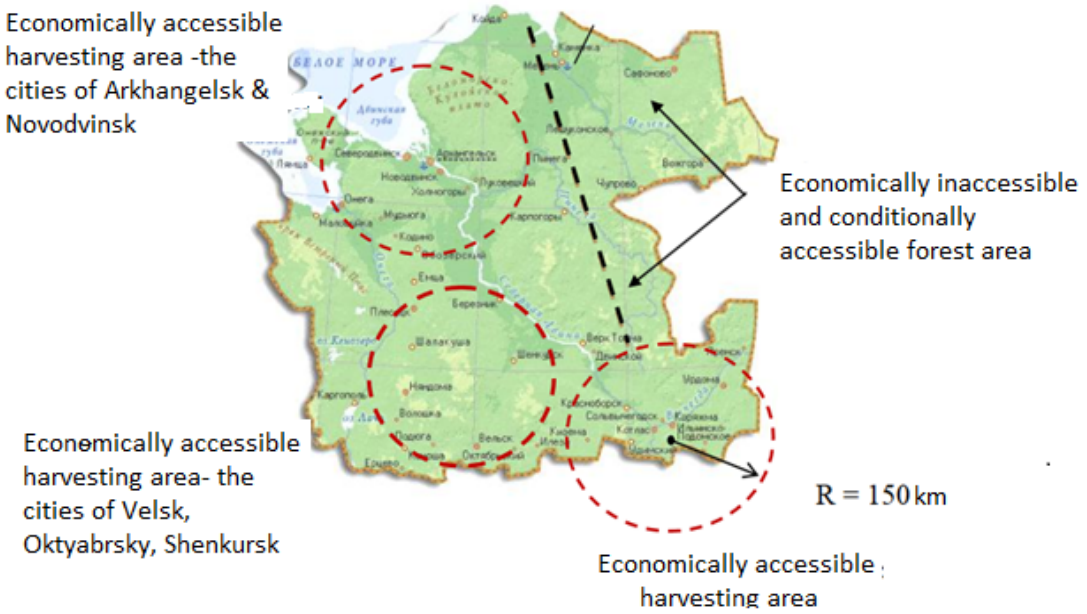

Figure 2 Economically accessible forest areas in Arkhangelsk oblast, Source: MNR 2016

Easily accessible forest areas along the transport corridors have been nearly exhausted. Thus, logging activities move further from the center and the transportation distance is getting longer. This results in higher transport costs that affects the economic competitiveness of the businesses (MNR 2016).

Some share of the leased forest areas to the forestry industries, such as the TITAN Group, the Sawmill 25 and the APPM, include the 'intact' forests. With the exhaustion of the easily accessible forests, the companies' activities have been gradually encroaching into the intact parts. Some of the intact forest areas have been recently assigned a special status of Protected Area by the regional government, where logging activities are not allowed to take place. This implies, however, that the other sites will be cut more intensively.

The federal government develops forestry plans for all regions in Russia for a period of 10 years. Based on the forestry plan the harvesting industries draw up harvesting plans that regulate the forest use. Lease holders in this regard work independently (interview with a forestry expert, 2017).

The forest in Russia is divided into three types:

a) Registered forest for planning and harvesting. These areas can include 'intact' or virgin forest.
b) Buffer zone forests (30% of all forest land) designed to protect forests around rural centres of population (villages). However, these can at times be part of the leased areas for forest management. There are also protected corridors along roads (500m) and rivers (50m to 3km).
c) Protected forests (designated protected areas). Nature reserves, national parks, wildlife sanctuaries, etc. The Government can also declare such status for forests that are important for local communities (income etc.), and the Government is sensitive to impacts on such communities. Protected sites can also be established in leased forests if it has red book (endangered) species. Protected areas can be established either by the Federal or State governments. In Nature Reserves no activity is allowed except non-invasive research. These areas cover 10-11% of forest land (interview with a forestry expert, 2017).

The regulations around commercial use, harvesting, management etc. apply to the first of these types, and have two parts. The first is fixed, and concerns issues such as regeneration/ replanting. The second part is flexible, and relates to such things as harvesting plans. These are made by the independent forest companies such as for instance the TITAN Group (ibid.).

There are approximately 6-7 million hectares of forest land that is certified by the Forest Stewardship Council (FSC) in the Arkhangelsk region, which constitutes more than 20% in the total share of the certified forests in Russia.

Characteristics of the timber industry

The timber industry complex of the Arkhangelsk region is the biggest in the Northwestern Federal District. In 2012, its share in the total Russian production of lumber was 7.6%, in pulp cooking 28.3%, and in cardboard manufacturing 33.5% (table 1) (MNR 2016).

The timber industry is the dominant sector in the regional economy. In 2012, it accounted for 45,2% of the shipping volume of the manufacturing industry, for 7% of the region's taxation and over 80% of exports from the region in the economic terms (MNR 2016).

The Russian pulp and paper industry is experiencing a period of strong growth. Much of its expansion is financed by inward Foreign Direct Investment (Panibratov, 2012).

The timber industry in the Arkhangelsk region specializes in the production of coniferous sawn timber, plywood, cellulose, paper products of various kinds, a wide array of solid timber products and products of wood chemical industry. Chemically treated timber dominates in the final products structure.

Table 1 The timber industry overview by product type in the Arkhangelsk region, 2013. Source: MNR 2016.

Product	**Thousand tons**
Pulp cooking	2223
Paper	357
Cardboard	954
Lumber	1956
Plywood	120

The timber industry in the region is predominantly export- oriented. The core volume (up to 70%) is produced by the following enterprises:

Sawmill 25 (*Лесозавод 25*), closed joint-stock company (JSC);

Arkhangelsk LDK-3 (*Архангельский ЛДК № 3),* open JSC;

Onezhsky LDK (*Онежский ЛДК*), open JSC;

Ustyanskiy Timber Industry Complex (*Устьянский ЛПК*), limited liability company (LLC);

Velskiy Les (*Вельская лесная компания*), LLC;

Wood pellets are manufactured at the Sawmill 25, Arkhangelsk LDK-3 and Velskiy Les. The largest sawmills are located in the cities of Arkhangelsk and Onega, and in Ustyansky district of the Arkhangelsk region. Plywood is produced at the JSC Arkhangelsk plywood factory in the city of Novodvinsk.

Out of a total 1371 organizations in the timber industry in the region (2012), about 54% are logging enterprises, 42% are wood processing enterprises. The largest enterprises are involved in pulp and paper production (Arkhangelsk Pulp and Paper Mill, Branch of OJSC Ilim Group), wood processing and wood products (Sawmill 25, Onezhsky LDK, Solombalsky LDK, Ustyansky Timber Industry Complex, Arkhangelsk LDK 3); wood logging (branch of Ilim Group in Koryazhma, Ustyansky Timber Industry Complex, Karpogoryles LLC, Ust-Pokshengsky LPH, Dmitrievsky LPH, Severny Les, and Onegales).

Although large companies account for the largest volumes of logging activities in the region, the number of SMEs in the timber industry has grown over the past decade. SMEs are predominantly involved in logging and timber production, lumber and planed products manufacturing, wooden buildings and furniture manufacturing.

Wood based housing construction is another promising area in the bioeconomy that has been increasingly promoted in Russia and in Arkhangelsk oblast (e.g. *Strategy for the development of the Russian forestry industrial complex until 2030, Strategy for Development of energy, communications and housing and communal services in the Arkhangelsk region for 2014-2020)*.

There is currently a rather low demand for wooden housing products such as roundwood, sawnwood, wood-based panels, structural wood-based products due to a low purchasing power of the population, but it is expected to grow in future. An increased construction of wooden housing may contribute to lowering the cost of construction by 1.5 times, and result in energy saving by about 15-20% due to reducing the use cement and reinforced concrete structures (Trubin 2015). There are several actors in the Arkhangelsk region that are already involved in the production of wooden housing parts, e.g. the companies of the PomorInovaLes cluster.

4 Waste resources and their management

Wood waste

As a result of the timber industry activities, over 5 million m3 of waste is being generated annually. Timber industry waste from logging operations, sawmilling and wood processing are excluded from the economic activities today. Given this, the utilization of already generated waste for bioenergy production or other purposes and increasing the efficiency of timber industry in order to avoid generation of large volumes of waste in future are among the high priorities in the region.

According to the waste management specialists interviewed, there is a considerably more attention paid in the region to the issue of utilization of wood waste, both in terms of incentives from the government and media attention, than other types of waste (interview 2017).

There is no recycling station for the pulp and paper waste in the Arkhangelsk region. The nearest pulp and paper recycling stations are at least 750 km away (e.g. in Vologda, Moscow or St. Petersburg) (interview 2017).

Chemical, industrial and hazardous waste

Large quantities of chemical, industrial and hazardous waste are among the most prominent challenges in the region. There are three Barents environmental hot spots in the Arkhangelsk region that are directly related to these types of waste (Barentsinfo 2017):

Code	Hot spot	Overview
A6	Toxic solid waste in Arkhangelsk Oblast	Quantities of solid wastes in Arkhangelsk Oblast increased more than three times since the 1st NEFCO/AMAP Report.
A7	Sites of former and current military activities as sources of oil contamination	Large areas in Arkhangelsk Oblast are strongly contaminated with petroleum fuel and spent motor oils, particularly due to former and current military activities.
A8	Spent motor oil	Since 1995, spent motor oil has not been collected and treated in Oblast, and became a serious source of the environmental pollution.

According to the Barentsinfo (2017), ca 38.4 million tons of waste has accumulated in the region, including 36.7 million tons of hazardous waste (class 5), based on the data from 2011. Moreover, the region has large areas that are strongly contaminated with petroleum fuel and spent motor oils, particularly due to former and current military activities (e.g. areas at Franz Josef Land are polluted with a large number of barrels and tanks, construction and household waste, scrap metal and petroleum products).

Some activities have been carried out to clean up the islands of Franz Josef Land. Initiated by the Russian Arctic national park, the clean-up campaigns are being organized annually with the help of workers and volunteers. The processed oil products and metal scrap are brought to the city of Arkhangelsk for utilisation (Barentsinfo 2017).

Among other waste management challenges in the region is illegal dumping of waste by the companies and individuals. Some clean-up campaigns are being regularly organized by the local authorities and the environmental NGOs, mainly relying on volunteer and activists support, as these actions rarely receive funding. The municipalities are lacking funding for removing the illegal landfills, even if detected (interview with an NGO 2017). Over 70 illegal waste dumps were mapped and about 15 of them removed in the region in 2017, as a result of a cooperation with the regional and local authorities in the framework of a General Cleanup project (Arctic 2017).

There are several inspirational examples of SMEs in the region advancing the recycling, reuse and upcycling principles. One of them is Ekoproekt in the city of Severodvinsk that runs tires recycling business. The company produces rubber coatings of different qualities and sizes that can be used as a material for playgrounds, stadiums etc. (Ekoproekt 2017).

Household waste

There is no separate collection of organic waste in the region at the moment. As of today, all organic waste goes directly to the landfill, without energy extraction. Another challenge is that the sewage treatment is poorly developed, particularly in rural areas (interviews with waste management experts, 2017).

In the city of Arkhangelsk, the recycling containers for glass, paper and aluminum were placed in some residential areas in 2014. There are about 200 recycling containers in Arkhangelsk today. The service is run by a waste processing plant which is a private company.

5 Bioenergy production

Wood biomass is used mainly for heat and power, and pellets production in the Arkhangelsk region. There is a high potential for local bioenergy production from the biomass residues due to large quantities of wood-based residues and waste generated by the sawmills and forestry industries in the Arkhangelsk region.

Local heat production

Wood waste is most intensively used to generate heat for local energy production (about 1 000 000 m^3 annually) (Dvinanews 2015a; Dvinaland 2015). Peat is not being used for bioenergy production due to long distances from the boilers. Wood-based heating prevails in the energy balance of Plesetsk, Shenkur, Verkhnetoemsky, Ustyansky, Kargopolsky districts. It is mainly chips and bark that are being used in the local energy segment. Some insular municipalities do not have good access to wood-based waste or any other local sources. For these types of municipalities, the use of solid fuels, such as pellets, is among the most economically feasible options (Dvinanews 2015b).

Pellets production

Arkhangelsk oblast accounts for about 21% of the total pellets production in the Russian Federation. The region has an installed capacity for production of 400 000 tons of pellets per year, of which 250 000 tons are wood-based pellets. The utilization of the forestry wastes for pellets production mainly takes place in the large industrial centers.

In 2015, a lignin-based pellets producing plant on the basis of a former Onega hydrolysis plant was launched, that accounts for about 150 000 tons of pellets. Due to the limited use of pellets in the domestic market, wood pellets are mainly exported to the EU. Only a small share is utilized in the region, mainly by the energy companies. After the completion of the investment programs by large enterprises in 2022, pellets production capacity is expected to increase by another 300 thousand tons per year (Environmental Investment Center 2017).

Bioenergy from landfills

Several feasibility studies on capturing methane from the landfills have been carried out in the Arkhangelsk oblast. The studies showed that the investment costs in biogas production are too high while the profits are quite low, as Arkhangelsk is a relatively small-sized city (350 000 inhabitants) (interview with a waste management specialist 2017). Arkhangelsk Pulp and Paper Mill is currently investigating the potential for landfill gas extraction from the sludge and other by-products from the cellulose production process.

Future opportunities

Despite the positive development trends, the region's potential for bioenergy production is underutilized. Arkhangelsk oblast is still highly dependent on the imported fuel (coal, fuel oil and gas). The imported resources account for about 86% of the fuel and energy balance of the region (2012) (Environmental Investment Center 2017).

There are large quantities of bark and wood waste accumulated in the region over several decades that could be a potential source of bioenergy (Dvinaland 2015). It is estimated that about 6.2 million m^3 of wood waste could be used for the bioenergy production annually, or 1.4 million tons of fuel equivalent (Environmental Investment Center 2017). The use of wood-based waste from logging and

woodworking industries for the production of bioenergy in the local municipalities is still limited (MNR 2017).

In addition, there is a potential for the utilization of 'dead' (dry) wood for energy purposes that has no economic value for timber industries. There are vast areas of dry forest stock located between the Northern Dvina and Pinega rivers, approximately 200 million m^3 of spruce forests.

6 Support framework for bioeconomy in the Arkhangelsk region

Forest-based bioeconomy

Promoting the utilization of forest industries' residues and sustainable forest management are among relatively new issues on the agenda of the national and regional governments that got a significant attention in recent years.

It was brought up in the interviews with the representatives from the forestry industries in the Arkhangelsk region that the Government in Russia is encouraging timber harvesting and processing businesses to introduce sustainable forest and waste management practices. The national forest legislation is in the amendment process. The new legislation will make use of the Scandinavian forest management experience to some extent (interview 2017).

The Ministry of Industry and Trade of the Russian Federation is drafting a "*Strategy for the development of the Russian forestry industrial complex until 2030*". The Strategy foresees a multifaceted utilization of forest resources and features different scenarios for growth. Among the highest priority areas outlined in the Strategy is turning the low-quality woody biomass and forest industries' waste into bioenergy, which today occurs only in three regions in Russia (Ministry of Industry and Trade of the Russian Federation 2017). Wooden housing construction is also among the prioritized areas. The Arkhangelsk region is among the forerunners in Russia in this regard and is already moving in the indicated direction (Unpublished meeting material 2017a).

In 2007, the Ministry of Industry and Trade of the Russian Federation adopted a legislation on the high priority investment projects in the field of forestry that aims at attracting investments in the industry. It envisages a more favourable forest lease fee for the implementation of the projects worth 300 million rubles (ca EUR 3 960 322) or more. In case of high priority investment projects the investor receives forest plots without an auction and for 50% of the regular lease fee (MNR 2016).

There are ten high priority large-scale investment projects being implemented in the Arkhangelsk oblast that support the development of advanced wood-working industries, pulp and paper, and plywood industries. The focus of the projects is on promoting further processing and increasing the value added of the products. The projects envisage investment support in further processing of the wood based residues (mainly pellets production) and setting up the facilities for wood waste disposal and management (e.g. bio boilers that provide energy for the needs of the industry and local residents). As an outcome of the investment projects the pellets production capacity in the region is expected to increase by 300 000 tons by 2022.

Four of the high priority investment projects are being run and operated by the PomorInnovaLes cluster companies. A total budget of the investment projects is about 60 billion rubles. These projects are primarily favouring large companies (Unpublished meeting material 2017a).

At the regional level, a conceptual programme "*Local heat supply development until 2030*" was approved by the governor of the Arkhangelsk region in 2014. The programme is part of the national programme "*Development of energy, communications and housing and communal services in the Arkhangelsk region for 2014-2020*". The programme promotes local bioenergy production through e.g. converting the municipal boilers to biomass. According to the conceptual programme, it is planned to gradually reduce the share of imported fuels and increase the consumption of bioenergy from 14% in 2014 to 44% in 2030 (MFA 2016).

There is no direct support for purchasing or converting boilers provided from the regional or federal budgets. In developing the local bioenergy, the authorities call upon the collaboration among the potential private investors, regional authorities and the municipalities.

In order to promote the implementation of the conceptual programme, a scheme was developed bringing together the potential investors, regional and local authorities. The core mechanism behind the scheme is the attraction of private investments, as well as the establishment of the investment programmes for biofuels to be implemented by the organizations involved in the energy production and distribution. The investment return is to be secured through a transparent mechanism of heat energy production tariffs (interview with forest industry representatives 2017).

The "*Strategy for timber industry development in the Arkhangelsk region until 2030*" was approved by the Ministry of Natural Resources and Timber Industry in the Arkhangelsk region in 2014. The main aim of the Strategy is to increase efficiency of the timber industry complex in the region through different means, such as the technological modernization, improving forest management and bioenergy production. Bioenergy production is seen as means to provide for own heat and power needs of the woodworking companies, and as means to reduce the expenses of the Arkhangelsk region associated with import of fuel for the municipal energy needs. The Strategy calls upon the national support measures, including tax- and investment incentives (MNR 2016).

In 2015, the Ministry of Fuel and Energy and Housing and the Ministry of Forestry of the Arkhangelsk region suggested a number of measures that could stimulate the consumption of biofuels in the municipal energy supply and attract investors in this area. Among the suggested measures are:

- introducing special certificates for the production of renewable energy ('green' certificates) entitling to receive state guarantees, tax benefits, compensation for falling costs and other state support instruments;

- developing a protection mechanism (return guarantees) for the private investments in the bioenergy projects with investments of up to 100 million rubles, which can be expressed by special taxation regimes for investors;

- introducing a project financing mechanism: favourable crediting to the resource-supplying organizations that implement the investment programs, at a percentage rate that does not exceed the profitability limit; or promoting the participation of banks as direct investors that receive a share in the total profit of the project (Dvinanews 2015b).

Moreover, the former governor of the Arkhangelsk oblast Igor Orlov stated at the ENES Energy Forum in 2015 that in addition to the importance of steering and support from the federal level, further development of bioenergy requires a number of additional measures. Among the measures suggested by the governor is development of the concession agreements on the basis of the transfer of municipal energy facilities to the private operators. For instance, if the business comes into the play and is interested in refurbishing the boilers to biofuel, then a concession agreement may be signed and the costs for refurbishment would be compensated to the business actor (Dvinanews 2015a; interview 2017).

In stimulating bioenergy production, the regional authorities are willing to both support the production of pellets for export and using chips and bark for satisfying the local population's energy needs. The benefits for the local community and local value added associated with the energy production from the local bio resources have been acknowledged by the regional authorities. To encourage local bioenergy production, the temporary storage sites for wood-based wastes are being set up in the region as one of the measures envisaged in the waste management programme (Unpublished meeting material 2017a).

These storage sites will be located in close proximity to the communal energy facilities or bioenergy production sites. This measure also aims at promoting the increased collection and utilisation of wood-based residues and reducing illegal waste dumping. Such sites have already been established in Shenkur, Plesetsk and Konosh districts. It is planned to set up five waste storage sites in Belsky, Shenkursky (2 sites) and Verkhnotoyemsky districts and the town of Kotlas. In Leshukonsky district, the wood-based residues from the industries are planned to be transported to the waste processing plant where heat and power will be produced for the use in district and communal services (Unpublished meeting material 2017a).

Waste management

Until recently there were no legal incentives for the households and companies to recycle waste as the tariff for delivering waste to the recycling station and to the landfill had been the same. In recent years, however, several important regulations to in the field of waste management were introduced.

In 2017, the territorial scheme for waste management in the Arkhangelsk region was adopted. The scheme promotes modernization of the existing waste management plants and elimination of dumps that do not comply with the regulations. Among other measures, it is planned to create two new and modernize 11 existing landfills, build five modern waste-processing complexes, as well as several waste sorting and waste transfer stations. In remote areas, the scheme provides for the construction of 25 waste incineration plants (Investinfra 2017). The programme also promotes production of briquettes and pellets from wood waste that could be utilized in the boiler plants. The boiler plants are expected to be built in the framework of the conceptual programme on local heat supply development until 2030 (Unpublished meeting material 2017a).

In 2017, a ban on landfilling the recyclable waste was introduced by the government. This measure is expected to accelerate separate collection of waste and recycling, stimulating demand for recycled products and prohibiting landfilling of the mixed waste (interview with waste management experts 2017).

Among other foreseen developments in the nearest future is upgrading the waste processing plant in Arkhangelsk that is responsible for waste management and recycling in the cities of Arkhangelsk,

Novodvinsk and Severodvinsk. New waste management facilities (recycling stations and a landfill) will also be built (read more 7.5).

7 Key actors involved in the bioeconomic activities in the Arkhangelsk region

Below is the description of the key actors involved in the timber industry complex, waste management and educational institutions in the Arkhangelsk region.

Arkhangelsk Pulp and Paper Mill (APPM)

Архангельский целлюлозно-бумажный комбинат

Arkhangelsk Pulp and Paper Mill (APPM) is among the leading chemical wood processing enterprises in Russia, and is among the largest enterprises in terms of pulp cooking. The company was founded in 1940 and it specializes in cardboard, bleached pulp and paper production (Barents Cooperation 2015). The APPM is located in the city of Novodvinsk with a population of 39 thousand people, where it is the main employer (APPM 2017a). Novodvinsk is located at the Severnaya Dvina river upstream from the city of Arkhangelsk. APPM provides the town with heating, water supply, and wastewater treatment (Barents Cooperation 2015).

Pulp and board dominate in sales volume, accounting for approximately 77 % of the revenues (2011) (APPM, 2017b). The production capacity at the APPM:

Pulp cooking - 970 thousand tons;

Sulphate pulp - 630 thousand tons;

Container board - 470 thousand tons.

Containerboard market share of APPM is approximately 25 % of Russian market total volume, and concerning pulp — 19 % from the volume of Russian goods market volume (APPM 2017b).

APPM exports its production to over 50 countries, with highest sales to Ukraine and Belarus, followed by Poland, Germany and Hungary (2011) (APPM 2017a).

The APPM is affiliated with the TITAN group and Pulp Mill Holding. Titan Group is the main supplier of wood materials for the pulp and paper mill.

In 2003, the APPM was included in the list of the Barents Hot Spots[2] due to large discharges of pollutants to the water and air. Despite increasing the production volumes of pulp and paper, the mill has achieved substantial environmental improvements over the past decade. Among the most important measures introduced were the reconstruction of boilers, installation of new filters and increasing the efficiency of production. Among the largest investments made was the reconstruction of mechanical and biological treatment of wastewater which had a positive impact on the environment. The measures introduced by the APPM resulted in a decrease in total discharges of pollutants to water by 54% and a decrease in total air emissions by 20% from 2003 to 2013. Due to these measures, the APPM was excluded from the list of hot spots in 2017 (Norwegian Environment Agency 2017).

[2] The list of 42 Barents Environmental Hot Spots was published in 2003 based on an earlier NEFCO and AMAP report for environmentally sound investment projects in the Russian part of the Barents region (Norwegian Environment Agency 2017).

In 2013, the APPM adapted a strategy on reduction of the greenhouse gas (GHG) emissions, aiming at 2.2 million tons CO_2 equiv. emissions reduction until 2020 (70% reduction in comparison with the baseline of 1990). Increasing the share of biomass in the fuel balance of the enterprise is among the strategic directions outlined in the strategy (Environmental Investment Center 2017).

The APPM was the first company in Russia to receive ISO 14064-1:2006 standard on GHG management, and was nominated as the best performing Russian company in the international Carbon Disclosure Project in 2014 (Staalesen 2016).

The APPM was also the first among Russian pulp and paper companies to offer FSC certified products to the market. The following products are currently FSC certified: kraft pulp, wrapping and packaging paper, cardboard, corrugating paper, offset paper, round wood, industrial chips, lumber and pellets (Lesprom 2017). The current FSC certificate is valid until 2021.

It is stated on the APPM website that the mill has achieved reduction of heat and electricity consumption by 23% and 11% respectively since 2003 primarily due to continuous modernization of its production sites and technological improvements (APPM 2017c).

Currently, the APPM is implementing the second stage of the mill's priority investment project on the reconstruction of the board machine and the construction of a new evaporation plant. The latter will be supplied by Valmet OYJ. Optimizing the existing technologies and implementing best available technologies will enable to reduce the formation of pollutants in the process cycle and reduce costs in the long term (Valmet 2017). The APPM is also planning to upgrade the technology for bleaching of pulp, which will have a positive impact on the ecology in the region and improve export opportunities to the European market (APPM 2017c).

Among the high priorities of the APPM is increasing the utilization of the by-products from the cellulose production process, such as sludge that is currently mainly stored at the landfill and emits methane. The company is investigating the possibilities of launching a project on landfill gas extraction for the mill's own operations. The project is currently in the research stage, where the Swedish Biogas Systems AB is involved a consultant (Environmental Investment Center 2017; BCLASS 2017).

The PomorInovaLes cluster

Timber Industrial Innovative Territorial Cluster of the Arkhangelsk region PomorInnovaLes is a relatively recently established cluster that was initiated by the APPM. Since 2014 it brings together 37 companies involved in timber harvesting and the production of various types of final forest products, as well as in the fields of transport, education, research and energy (GISIP 2016).

The cluster is organized as a cooperative. The cluster companies produce container board (including corrugating paper), white offset paper, timber, plywood, furniture, wooden housing, and pellets). It has a mission to become the leading cluster in Russia within sustainable forest management and manufacturing of high quality timber and paper-based products using innovative technologies.

The cluster is referred to as a flagship project, and the first innovation- driven cluster in Russia. It is viewed as a good practice in the region that could serve as a model for developing similar initiatives elsewhere in Russia. The initiative has received a strong support from the Governor of the

Arkhangelsk region and the relevant federal executive authorities, and NGOs within the timber industry. The cluster was also highlighted as an important initiative in the "*Strategy for timber industry development in the Arkhangelsk region until 2030"*.

The main goal for the establishment of PomoInnovaLes was to create a favorable environment for introducing innovations and improving the performance of all enterprises and organizations involved in the cluster. The cluster operates its own programme identifying the priority projects and seeking multifaced utilization of wood based resources, including the development of higher value-added products (Unpublished meeting material 2017a).

The cluster facilitates the development of joint and individual projects of the cluster members, particularly when it comes to renovation of the production facilities, joint R&D and pilot projects in the field of reforestation, new products and technologies development (i.e. wooden housing), and education (i.e. development of forestry vocational education and training programs). Some of the challenges of the cluster companies, such as high cost of production, poor infrastructure and low qualification level of the staff, can be addressed through cooperation among the members (Unpublished meeting material 2017b).

The total cutting area of the cluster companies is about 277,300 m^3. Among the largest cluster companies are the APPM, the TITAN Group, Arkhbum pulp mill holding, and Sawmill 25, while the rest of the members are mainly SMEs. Each of them make own investments in the equipment and refurbishment, machinery, boilers and wood transportation vehicles.

The cluster companies are widely spread all across the territory of the Arkhangelsk region: Pomorskiy, Plesetsk, Kholmogory and Pinega municipalities, and in the cities of Novodvinsk and Arkhangelsk. The member companies mainly leave logging waste in the forest. Some share of the sawdust and chips is being combusted in local boilers and the heat is used for drying facilities, although the energy production efficiency is rather low (about 50%). Due to remote location of some member companies and large distances, the production of pellets is not economically feasible (interview 2017).

According to the interviewees, attracting the companies to become members has been relatively easy, as they were offered better market opportunities. There was almost no forest plots left for leasing in the region in 2011, and no auctions were organized. PomorInnovaLes offered favourable leasing conditions to the companies for 100 rubles per m^3.

The cluster cooperates with transportation and service enterprises, educational institutions, research centers, law firms and advertising agencies (APPM 2016). Business and state cooperation has been the cornerstone of these activities. The total volume of investments in the cluster activities until 2020 amounts to approximately 4323 billion RUB, including the state support.

By 2020, the cluster aims at achieving significant cost savings as a result of the technological modernization, increasing sale revenues by 26%, generating an economic impact and job creation.

The TITAN Group

The TITAN Group is a holding consisting of 20 enterprises in the Arkhangelsk region and other regions founded in 1990. The TITAN Group is involved in different economic activities, and the timber industry is one of them (PomorInnovaLes 2016; Titan Group 2016).

The enterprises are involved in logging and wood processing activities. TITAN is among the leading forest-based industries in the Arkhangelsk region when it comes to the volumes of leased forest, logging activities and production of industrial wood (ibid.).

The TITAN Group has a high level of cooperation with the PomorinovaLes cluster and supplies timber to other cluster member companies, such as the APPM, Arkhangelsk Plywood Plant and Sawmill 25 (PomorInnovaLes 2016).

In total, there is about 2 million m^3 of forest plots in the long-term lease of the TITAN Group. More than 80% of works are carried out using cut-to-length harvesting technology. The enterprises in the TITAN Group have acquired the FSC certification for compliance with forest management standards in 2005 and were re-certified in 2010. FSC certification is particularly important as it gives a better access to the foreign markets (ibid.)

The TITAN Group aims at constantly improving its forest management practices, making them more environmentally sustainable. The TITAN Group is currently working on developing a long-term strategy for sustainable forest management that will seek to reconcile interests of different stakeholder groups, including the rural communities and authorities. The TITAN Group is ahead of other companies in Russia when it comes to the adoption of sustainable forest management practices (interview with business representatives 2017).

The TITAN Group and the APPM approved a strategy on *Sustainable forest management and certification* in 2003 and a FSC-POL-01-004 Declaration (the FSC association policy) in December 2011. In cooperation with Greenpeace Russia and WWF Russia the TITAN Group have developed methods of sustainable forest management within the leased forest areas of the TITAN Group (APPM, 2017; Lesprom 2017).

Sawmill 25

Sawmill 25 (*Лесозавод 25*) is a subsidiary of the TITAN group. The company's core activity is production of spruce and pine sawn timber and wood pellets. Sawmill 25 is a closed cycle production plant, where pulp is produced from chips and sawdust goes to pellets production. Some pellets are used in local municipal boilers, while bark and part of sawdust goes for combustion at Sawmill 25 own boilers for heat production.

Pulp chips are sold locally as by-products. It is the leading enterprise in Northwest Russia in terms of production volumes and technical level of production. In the lease of Sawmill 25 is about 1 million hectares of forest. In 2015, the sawmill reached the annual production of 1136 thousand m^3 of logs. The annual timber production exceeds 498 thousand m^3, of them 99% goes for export. The main

export destinations are Western Europe, North Africa, the Middle East. Pellets are sold to Finland and Sweden, and also supplied to a member of the cluster Arkhbioenergo LLC, servicing boiler plants in the Primorsky district. Technological chips are shipped to the APPM.

The company's annual turnover is about 70 million euro (Sawmill25 2017). Sawmill 25 produces about 2.3% of the volume of the Russian output of sawn timber and 7.2% of the volume of fuel pellets. Sawmill 25 provides pellets to six biofuel boiler plants in the suburbs of Arkhangelsk.

The annual production capacity at Sawmill 25 is 1 million m^3 sawn raw materials (498 thousand m^3 for sawn timber) and 120 thousand tons of wood pellets.

Improvements of the production technologies and modernization are high on the agenda of the sawmill, both as measures for increasing the economic outputs but also achieving the environmental benefits. Sawmill 25 has acquired FSC-certification which has a vital importance for an export-oriented company. Sawmill 25 cooperates with NGOs, such as Greenpeace and WWF. The company is a member of the Association of Environmentally Responsible Timber Producers of Russia (Sawmill25, 2017).

A plant for production of fuel pellets from sawmill residues at Sawmill 25 was initiated in 2007 and was registered as a joint implementation project by the UNFCCC in 2012 (JI UNFCCC 2017). The sawdust and bark wood waste (BWW) generated at the mill are used as feedstock and fuel for the pellets plant. The project allows to utilize about 180 000 m^3 of BWW and sawdust per year, thereby avoiding disposal to the dumps (CCGS 2008). The reduction of the GHG emissions from 2008 to 2013 was estimated to 215 362 tons of CO_2-equivalent (Sawmill25 2017).

Arkhangelsk waste processing plant

The waste processing plant in Arkhangelsk was established in 2002. It provides waste management services (collection, transportation, disposal, recycling and placement of solid household waste, bulky waste and medical waste) in the cities of Arkhangelsk, Novodvinsk and Severodvinsk.

Since 2014, the company introduced separation of waste at source. There are about 200 recycling containers in the residential areas of the city of Arkhangelsk, collecting glass, paper and aluminum. The recycling unit of the waste management plant uses manual labour and receives about 20-24% of the total waste produced in the area.

In 2013, a concessional agreement (public-private partnership) was signed to create common waste management facilities (recycling stations and a landfill) for the cities of Arkhangelsk, Novodvinsk and Severodvinsk. The concessioner will build a new waste processing plant and a 1.5 hectares landfill. The new landfill will be modernized and have video fixators, air flow dividing the waste, and less manual labour will be used. The current landfill in the city of Arkhangelsk will be closed. When the new landfill is built, it is estimated that about 70-80% of industrial waste will be recycled, and only 20% landfilled.

The existing recycling unit at the waste processing plant will be upgraded. It will have two waste sorting lines – one line for commercial/industrial waste, and the other one for household waste.

Educational and research institutions

The Northern (Arctic) Federal University named after M.V. Lomonosov (NArFU) is the leading higher education institution. In addition to the campus in Arkhangelsk, it has three other branches in the cities of Severodvinsk, Koryazhma and Naryan-Mar.

Among the focus areas of NArFU are the development of high-tech knowledge-intensive industries; infrastructure development in the European part of northern Russia and the Arctic; integrated use of bioresources; protection and preservation of the environment; social and humanitarian sciences.

Among other academic institutions in the region are the Arkhangelsk Scientific Center of the Ural Branch of the Russian Academy of Sciences (UrB RAS), the Institute of Environmental Problems of the North of the UrB RAS, the Institute of Physiology of Natural Adaptations of the UrB RAS and the Arkhangelsk Research Institute of Agriculture.

The main vector of development of science and higher education is the task of developing the Arctic zone of the Russian Federation. In 2015, the decision was taken to establish the Federal Research Center for the Integrated Study of the Arctic of the Russian Academy of Sciences and to establish a scientific laboratory. The key mission of the center is the formation of a specialized competitive research and scientific and technological development.

NArFU and the Arkhangelsk Pulp and Paper Mill have a long-term cooperation agreement benefiting both parties. It aims at increasing the attractiveness of education in the forest related industries, testing and applying the innovative solutions developed by students and employees of the NArFU at the APPM, improving the existing educational programmes and courses to better meet the needs of the industry, training and upgrading the skills of the employees, etc. (APPM 2017d).

There are several joint implemented and ongoing projects initiated by the timber industries in the region with the involvement of the NArFU specialists. Among those are projects on the construction of residential wooden buildings, development of the technology for the combustion of wood fuel, design and construction of a bio-boiler plant, piloting the forestry machinery for biomass processing, and other industry-specific projects (MNR 2016).

8 Discussion

Bioeconomy is not a widely used concept among the private and public actors in the Arkhangelsk region today. The regional companies specialize in the traditional forestry activities, and in the absence of steering and support from the national and regional levels, the transition to the bioeconomy is at a rather starting phase.

At the same time, the Arkhangelsk region is among the forerunners in Russia when it comes to the sustainable forest management practices, the adoption of the environmentally friendly practices in the forestry industry, development of circularity, and is ahead of many other regions when it comes to bioenergy production. It has many positive examples of successful initiatives: from wood based pellets production to using wood waste for local energy production. There are also successful examples of SMEs involved in a circular economy, e.g. recycling of tires.

Within different bioeconomy sectors, the development of bioenergy has gained the most prominent attention in the region in recent years, primarily due to large volumes of wood-based residues generated in the region. There is an increasing understanding of the potential of using wood waste as a resource among the regional businesses and authorities.

The regional and local authorities view bioenergy as a cheap and locally available alternative energy that could substitute the imported fuel and save costs. The cost of wood-based local fuels is about 23% lower than of coal and oil (Lopatin 2015). Reducing the energy production cost is both in the interest of businesses and local authorities (interview with forestry industry representatives 2017). In the Arkhangelsk region, wood based residues from sawmills and forestry industries are used for manufacturing wood- and lignin-based pellets, as well as direct burning for heat and power production for the internal use by the companies and municipalities.

According to the interviews with the representatives of both large companies and SMEs, as well as public sector representatives, business sector is the main driver for a 'greener' development in Russia today. The forestry businesses are highly interested and willing to embark on a green economy pathway, as they see direct economic benefits of bioenergy production and are realizing that 'green' thinking is crucial for the long-term sustainability of their activities and especially for achieving a competitive advantage at the EU markets.

All successful industries in the region have adapted this thinking to some extent. The Sawmill 25, whose management has timely invested in the modernization of the industry, is often brought up as a success story that sets a positive example for other companies in the region (interviews 2017).

The utilization of wood-based residues has gained significantly more attention in the region, both by the authorities and companies, than the utilization of other types of industrial waste, probably due to a better market value of wood based residues. There are large quantities of industrial waste in the region accumulated from the Soviet era until today. Some feasibility studies have been carried out on the potential of landfill gas extraction from the landfills but no promising results have been achieved so far.

At the same time, landfilling of waste requires extra space and costs money. With a gradual advancement of the waste management legislation in Russia, landfilling will become more expensive, and the companies will be increasingly interested in finding alternative ways of getting rid of the waste. Moreover, landfilling may cause the environmental problems, resulting in fines and duties imposed by the authorities, or even closure threats. The companies that have by-products that are

suitable for combustion increasingly prefer investing in bio-boilers rather than landfilling. However, in reality, the high costs of new technologies and lack of investments often results in choosing the less sustainable and cheapest options.

Besides bioenergy, wooden housing construction is another promising area in the bioeconomy that has been promoted both at the national and regional level. Timber architecture is also gaining popularity all across Europe, due to exceptional qualities of wood as insulator and energy saver, carbon emissions reduction, costs savings due to quick building process, and other mechanical and working properties (Freshome 2014).

Key challenges and opportunities for bioeconomy

Insufficient state support and steering

Among the key challenges for bioeconomy development in the region is a lack of steering and support from the federal level. There is a lack of state support to the bioenergy consumers for the development of the domestic market and a lack of economic room for the regional and local authorities to operate and drive the initiatives.

The conversion of boilers from oil to bio is costly and requires attracting investors. In the conditions when the credits and loans are highly costly, the conventional fuel is rather cheap and the state incentives to support the process are limited, the success of bioenergy development in the region is undermined (interviews 2017).

To achieve positive and meaningful results, the regional authorities emphasize that there is a need for developing a strategic guidance and support framework from the federal level. The state support is seen crucial for creating an economic interest from the businesses to invest in the utilization of low-quality woody biomass and industry by-products (interviews 20017).

Shortcomings in the environmental legislation

Shortcomings in the legislation was mentioned in the interview with the environmental NGO. There is a general mistrust in the environmental monitoring bodies and authorities by the businesses, claiming that the environmental legislation today is viewed as a source of income and is often misinterpreted. Moreover, current bureaucratic procedures make it challenging for any new actors to get a license and enter the market (e.g. in the field of recycling). In the licensing process, the federal laws can be interpreted in different ways by the inspectors.

The issues of utilisation of low quality wood, wood-based residues or 'dead' wood for energy production purposes are not addressed in the legislation. This enables the companies to avoid the utilization of bio-based waste generated by their facilities, which also leads to the illegal dumping of waste in the forest (interview 2017).

The sanitary regulation should also be renewed. Today's legislation does not allow to put recycling containers in schools.

Labour market and cooperation between business, education, regional authorities and civil society

Increasing scarcity of labour resources due to migration and urbanization trends, as well as low interest in working with the forestry issues among the younger generation represent significant challenges for the future of the industry in the Arkhangelsk region, as elsewhere in Europe (MNR 2016). In this connection, the interviewees mention that the age gap in qualified staff and a lack of younger professionals are among the biggest challenges.

Large forestry companies have a longstanding cooperation with the educational institutions. At the same time, it is stated in the '*Strategy for development of the timber industry complex in the Arkhangelsk region until 2030'* that NArFU's influence and role in the economy of the timber industry complex is currently limited. Therefore, further strengthening the industry and university cooperation could bring significant benefits for both sides, also when it comes to unlocking innovation capacities and modernization of the industry. Large companies are also willing to develop a closer collaboration with the regional authorities, e.g. on introducing certain incentives for people who plan to pursue careers in the forestry industries, such as allocating residential flats and tax incentives (interviews 2017).

The Arkhangelsk region could benefit from a greater involvement of local inhabitants and civil society actors in the transition to a bioeconomy. Bioeconomy is about a larger societal transformation aiming at changing norms and values, consumer behaviour and production and consumption patterns. Thus, the involvement of residents in the bioeconomy transition is crucial. Moreover, residents involvement helps to ensure legitimacy of bioeconomy initiatives at the community level, building long-term trust and local ownership.

Geographic specificities and infrastructure

The geographic specificities of the region, long travel distances, poor accessibility and infrastructure may also hinder further expansion of bioenergy. The dispersed location of the sawmills and their small size represents a challenge for getting enough volume of wood-based residues and chips in some areas of the Arkhangelsk region. At the same time, high costs for maintaining a grid-based infrastructure system may encourage the development of local off-grid bioenergy based energy systems (interviews 2017; Unpublished meeting material 2017a). In the areas of high concentration of logging and timber processing industries, the use of fuelwood and timber waste represents a great potential as a substitute for fossil energy. The production of charcoal, briquettes and pellets, motor fuel from wood and technological wood chips are on the rise (Trubin 2015).

Building forest roads and improving social infrastructure are also among the issues of a high priority highlighted by several stakeholders in the Arkhangelsk region. Improving transport infrastructure (public roads), energy supply, and developing social infrastructure (housing, social services) are among the necessary preconditions for the companies to continue logging activities in more remote areas of the region. In the context of the Arkhangelsk region, for every 1 million m^3 of harvested wood it is necessary to build about 33.8 km of technological roads, which are used in the interests of both forestry companies and forest management (Trubin 2015).

When it comes to the practical issues, low efficiency of boilers and high heat losses in the distribution system are among the hurdling factors for bioenergy expansion. Boilers are owned by the municipalities and lack of funding for their refurbishment is often an impeding factor.

Forest management

It was highlighted in the '*Strategy for development of the timber industry complex in the Arkhangelsk region until 2030'* that the Arkhangelsk region is characterized by uneven and extensive forest utilization. The forest reserves are decreasing rapidly in the accessible parts of the region, and the industries might face challenges in meeting the current and future demand for raw materials already in the short-term.

Another challenge outlined in the Strategy is the deterioration of the qualitative composition of forests, associated with the depletion of the estimated felling area for coniferous species and with increase in deciduous plantations. The unfavorable pathological situation in the forests in several districts in the region also poses challenges. Moreover, the drying up of spruce forests requires increasing sanitary felling, developing new technologies and measures for the use of deadwood. Drying is caused by the drop in the level of water table that could be the result of the climate change.

The effectiveness of forest management in Russia is constrained by poor control over use, preservation, protection and reproduction of forests, low level of use of modern information technology, poor quality and lack of access to the public information on forests and lack of funding work (Trubin 2015).

There are many cases of illegal logging, forest fires, pest outbreaks and other adverse factors affecting the quality of a forest fund. The levels of reforestation are low and there are too few forest plantations in Russia (Trubin 2015).

Education and awareness raising

Increasing the environmental awareness of the population is an important precondition for bringing about the change and facilitating the transition to a bioeconomy, and was brought up as an important measure by the regional authorities, businesses and the environmental NGO. Improving access to information on the environmental issues, awareness raising measures, increasing networking and cooperation between different actors in the society are among the necessary measures that could also stimulate the consumption of biofuels among the local population, encourage the emergence of new business models based on circularity etc.

9 Future perspectives

Based on the discussions at several meetings in Arkhangelsk and in Joensuu, Finland, several topics of interest for Nordic-Russian business and research collaboration in the field of forest- and waste-based bioeconomy have been identified:

- Intensification of forest management and reforestation;
- Increasing the efficiency of forest inventory. Geoinformation system in forests, using Scandinavian experience;
- Wooden housing construction;
- Forest roads construction;
- Biorefineries - experience and knowledge sharing;
- Developing sustainable rural business models (independent cooperatives, energy-self-sufficient communities, housing communities, crafting)
- Capacity building of formal and informal leaders (mayors, leaders of the local action groups, driven individuals, interest organizations, farmer cooperatives etc.) in rural areas in bioeconomy related issues;
- Facilitating and building networks. Developing joint working methods between private and public sector, business and NGOs.
- Business-oriented cross-border cooperation in training and education of experts and other relevant stakeholders
    - Developing competences and cooperation in e.g. sustainable uses of natural resources, renewable energy, waste management, raw materials, forestry, environmental viability, wastewater management.
    - Capacity building. Education of youth. Distance learning
- Awareness raising for local communities on sustainable practices
    - Developing networks between civil society, local authorities, NGOs
    - Education, dialogue, information to and with different groups in the society, schools in particular
- Exploring partnership and cooperation mechanisms that advance local bioeconomy in a sustainable way and add value locally
    - Local ownership and citizens inclusion

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